HPW

152

Vol. 12 JULY, 1918 No. 1

QUARTERLY

OF THE

National Fire Protection Association

Entered as second-class matter May 1, 1911, at the Post Office at Boston, Mass., under act of July 16th, 1894.

87 MILK STREET, BOSTON, MASS.

EDITED BY THE SECRETARY

National Fire Protection Association.

Executive Office, 87 Milk Street, Boston, Mass.

Franklin H. Wentworth, Secretary

July, 1918

Members

American Institute of Architects.
American Institute of Consulting Engineers.
American Institute of Electrical Engineers.
American Institute of Mining Engineers.
American Ceramic Society.
American Gas Institute.
American Electric Railway Association.
American Paper and Pulp Association.
Arkansas Actuarial Bureau.
Associated Factory Mutual Fire Insurance Co's. Inspection Bureau.
Associated Manufacturers of Electrical Supplies.
Associated Metal Lath Manufacturers.
Association of Edison Illuminating Companies.
Association of Fire Underwriters of Baltimore City.
Board of Fire Underwriters of Allegheny County.
Board of Fire Underwriters of the Pacific.
Board of Fire Underwriters of the Territory of Hawaii.
Boston Board of Fire Underwriters.
Buffalo Association of Fire Underwriters.
Bureau of Explosives.
Canadian Fire Underwriters' Association.
Canadian Manufacturers' Association.
Chicago Board of Underwriters of Chicago.
Clay Products Association.
Committee of Manufacturers on Standardization of Fittings and Valves.
Compressed Gas Manufacturers' Association.
Cotton Insurance Association.
Electrical Supply Jobbers' Association.
Factory Insurance Association.
Factory Mutual Laboratories.
Fire Prevention Bureau of the Pacific.
Fire Underwriters' Electrical Bureau.
Florida Fire Prevention Society.
Gas Products Association.
Gypsum Industries Association.
Illinois Inspection Bureau.
Illinois State Fire Prevention Association.
Indiana Inspection Bureau.
Indiana State Fire Prevention Association.
Institute of Makers of Explosives.
Insurance Association of Providence.
International Acetylene Association.
International Association of Fire Engineers.
International Association of Municipal Electricians.
Iowa Insurance Service Bureau.
Iowa State Fire Prevention Association.
Kansas Inspection Bureau.
Kentucky Actuarial Bureau.
Kentucky State Insurance Board.
Louisiana Fire Prevention Bureau.
Louisiana State Society for the Reduction of Fire Waste.
Mainland Fire Underwriters' Association of British Columbia.
Massachusetts Mutual Farm Inspection Bureau.
Massachusetts Mutual Fire Insurance Union.
Michigan Inspection Bureau.
Michigan State Fire Prevention Association.
Millers' National Federation.
Mississippi Inspection and Advisory Rating Company.
Mississippi Society for the Prevention of Fires.
Missouri Inspection Bureau.
Mutual Fire Prevention Bureau.
National Association of Building Owners and Managers.
National Association of Credit Men.
National Association of Electrical Contractors and Dealers.
National Association of Electrical Inspectors.
National Association of Insurance Agents, The
National Association of Manufacturers of Approved Hollow Metal Window Frames and Sash.
National Association of Manufacturers of United States.
National Association of Master Gravel and Slag Roofers of America.
National Association of the Motion Picture Industry, Inc.
National Association of Sheet Metal Contractors of United States.
National Automatic Sprinkler Association.
National Board of Fire Underwriters.
National Commercial Gas Association.
National Convention of Insurance Commissioners.
National Electric Light Association.
National Implement and Vehicle Association.
National Lumber Manufacturers' Association.
National Paint, Oil and Varnish Association.
National Warm Air Heating and Ventilating Association.
National Wholesale Druggists' Association.
National Wholesale Grocers' Association.
Nebraska Inspection Bureau.
New Brunswick Board of Fire Underwriters.
New England Bureau of United Inspection.
New England Insurance Exchange.
New Hampshire Board of Underwriters.
New Jersey Schedule Rating Office.
New York Board of Fire Underwriters.
New York Fire Insurance Exchange.
Newfoundland Board of Fire Underwriters.
North Carolina Fire Prevention Association.
Nova Scotia Board of Fire Underwriters.
Ohio Inspection Bureau.
Ohio State Fire Prevention Association.
Oklahoma Inspection Bureau.
Philadelphia Fire Underwriters' Association.
Philadelphia Suburban Underwriters' Association.
Portland Cement Association.
Rocky Mountain Fire Underwriters' Association.
Society Advocating Fire Elimination.
Society of Motion Picture Engineers.
South Dakota State Fire Prevention Association.
Southern Cypress Manufacturers' Association.
South-Eastern Underwriters' Association.
St. Louis Fire Prevention Bureau.
Suburban Fire Insurance Exchange.
Tennessee Fire Prevention Association.
Tennessee Inspection Bureau.
Texas State Fire Insurance Commission.
The Union.
Underwriters' Association of the District of Columbia.
Underwriters' Association of the Middle Department.
Underwriters' Association of New York State.
Underwriters' Bureau of Middle and Southern States.
Underwriters' Bureau of New England.
Underwriters' Laboratories.
Underwriters' Service Association.
Vancouver Island Fire Underwriters' Association.
Water Works Manufacturers' Association.
Western Actuarial Bureau (Fire).
Western Canada Fire Underwriters' Association.
Western Canada Grain Association.
Western Factory Insurance Association.
Western Insurance Bureau.
Western Sprinklered Risk Association.
West Virginia Inspection Bureau.
Wisconsin Inspection Bureau.
Wisconsin State Fire Prevention Association.

Table of Contents.

Detroit Firemen in Elevator Fire	Frontispiece
Editorial	5
Meeting of Executive Committee	14
Shingle Roof Conflagration at Fulton, S. D.	16
The Shingle Roof in China. (Illustration)	18
Report of Fire Prevention Section, War Industries Board, U. S.	19
An Excursion into Fire Protection History	21
Charring of Wooden Supports by Steam Coil. (Illustration)	28
Loss of Life from Common Hazards	29
Oil Leakage Causes Transformer Failure. *Francis Miller*	37
Comparative Statistics of Fire Loss	38
Tobacco Waste and Fire Hazard. *Henry W. Farnam*	42
Standardization of School Buildings	49
Strikes in Fire Departments	55
How Army Hospitals are Being Protected Against Fire	59
Influence of Ground Connections on Lightning Arrester Performance. *E. M. Cohen*	65
The Chlorates. *F. M. Griswold*	67
Note on Chlorate of Potash. *William J. Tallamy*	71
Leaks from High Pressure Fire Service Mains. *Henry B. Machen*	72
Planning Factory Water Supplies for Emergencies. *Charles E. Worthington*	76
New Hazards in the Rubber Industry. *Benjamin Richards*	83
Department of Fire Record	90
Fuel Oil Hazards—Fire Record	90
Jarvis Warehouse Fire, Jersey City, N. J.	96
Central Oklahoma State Hospital Holocaust	98
Stationary Chemical Extinguisher Fire	101
Points of Interest from Fire Reports	102
Fire Causes	107

Reports on fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

Courtesy of Michigan State Fire Marshal.

DETROIT FIREMEN IN AN ELEVATOR FIRE.

The grain destroyed in this fire would have made millions of loaves of bread.

Keep the Home Fires Burning!

Let the children play with matches. Permit the cook to start the fire with kerosene. Burn trash in the backyard, especially on windy days. Let soot accumulate in the chimneys. Set the stoves too close to the woodwork. There are many other ways in which we can continue to burn our homes, but for further data on the subject apply to the chief of the fire department.—*Southern Construction News.*

The grain destroyed in this fire would have made millions of loaves of bread.

The Quarterly

Vol. 12 July, 1918 No. 1

The Twenty-second Annual Meeting.

Members who had misgivings as to the success of the Association's meeting this year were agreeably disappointed. The membership representation was quite up to the average—exceeding the average from Canada—and the topics discussed gained rather than lost interest by the influence of the war, the connection with which was made rather intimate by Mr. Mallalieu's paper, *The Public Service of the Fire Underwriter in War Time* and Past-president Merrill's description of the functions and intent of the new Fire Prevention Section of the War Industries Board, of which he is sectional chairman.

The discussion of hotel and apartment house protection was interesting, Mr. Jensen's paper and Mr. Williams' remarks being supplemented by comments on certain features of hotel protection and management by Mr. Ernest J. Stevens, vice-president and manager of Hotel LaSalle, who was present as the guest of member Oscar B. Ryon.

The noon luncheon on Wednesday arranged by our Chicago Chapter Secretary, William S. Boyd, was, in spite of the fact that neither the expected chairman nor the expected speaker was present, the star event of the meeting. Our honorary member, Col. Henry C. Eddy, introduced the speaker with his accustomed dignity and grace, and it is no disrespect to the Reverend Dr. Gunsaulus to say that he was not missed. Dean Louis C. Mon'n, of the Armour Institute of Technology, stepped into the breach with an impromptu speech, the wit, imagination and charm of which it would be difficult for any speaker to surpass. After the luncheon the members spent the afternoon in the usual biennial visit to Underwriters' Laboratories, the interest of which was especially heightened by an inspection in action of the new column-testing machinery. Vice-presidents Robinson, Pierce and Small were the hosts, President Merrill having been recalled to Washington Wednesday morning.

The committee-reports, while not as numerous as usual, were more copiously discussed. Our members do not usually go snipe-shooting when bears are in sight, but the belligerent spirit of the times seemed unconsciously to manifest itself at moments in the discussions. When things themselves were not open to attack, the members rode full tilt at phantasms of things. The chairmen of the committees making the reports stood by, however, with persistent good nature while their butterflies were being dynamited, and the explosives served therefore only to add to the gayety of the session. A guest of the Association present for the first time remarked that to be chairman of an N. F. P. A. committee one must be a good sport—which opinion is shared by many.

Mr. Forster, whose report on *Safety to Life* was so furiously assailed at the Washington meeting last year, had subsequently so successfully taken the enemies of his position into camp that his report went through on rubber tires. The force and logic of his findings roused not even a feeble resistance this year. Some of the other technical committees were not so successful, although Mr. Woolson's report on *Fire-resistive Construction*, always carefully and thoroughly prepared, was adopted, as was also Mr. Franke's on *Uses of Wood in Building Construction*, the acceptance of which will again give the Association standard regulations for slow-burning building construction. Mr. Dana's report on *Scuppers*, prepared by the *Committee on Tanks*, was adopted; as was Mr. Robinson's amendment to the regulations for *Protection of Openings in Walls and Partitions*, which was so voluminously discussed last year. Mr. Strong's report on *Nomenclature* was also favorably considered, and Mr. Lacount's amendments to the regulations for *Fire Pumps*, and *Hydrants and Valves*, were passed without debate.

The Association added one name this year to its list of honorary members—that of Mr. F. E. Cabot of Boston.

* * * * *

When Fires Are Prevented.

In the discussion of the report of the *Committee on Public Information* at the Annual Meeting, the case of Indianapolis in 1913—when a bad flood put the fire department out of commission for several days, during which period no fires occurred—was cited to prove that fires not only can be, but are, prevented as soon as people are convinced that they themselves are likely to be in serious trouble if fires occur. The following resolution, drafted by a Citizens' Committee of 100, organized during the recent strike in Winnipeg to assist the city in carrying on the public utilities, tells exactly the same tale:

WHEREAS the fire loss in the City of Winnipeg has reached proportions which place a burden upon the city's industry, prejudicial to its commercial interests;

AND WHEREAS the City of Winnipeg has been singularly immune from fire during the strike of the firemen, and such immunity in the opinion of this committee is largely due to common precautions against fire taken by property owners, merchants and householders during the period of disorganization of the fire brigade:

BE IT RESOLVED that in the opinion of this committee adequate measures should be taken by the municipal or provincial authorities for the adoption and enforcement of legislation and regulation for the prevention of fires;

AND THAT a copy of this resolution be forwarded to the Premier of the Province and the Mayor of the City with request for consideration and necessary action;

AND BE IT FURTHER RESOLVED that the Citizens' Research League be asked to bring to date and reissue its report of last year upon the subject of Fire Prevention and Fire Fighting in the City of Winnipeg.

Too much publicity cannot be given to incidents of this sort, and it is hoped that members will promptly notify the *Committee on Public Information* of all such cases coming under their notice. A goodly array of instances will be of great help in convincing the public that an individual liability ordinance will only penalize the citizen who fails to do for the public good what he finds no difficulty in doing when he thinks it worth while for his own sake.

* * * * *

"Greene Park" to be Made Safer. It is gratifying to learn that as a result of the efforts of Fire Marshal Harry W. Bringhurst (Member N. F. P. A.) some precautions are to be taken to improve the terribly dangerous conditions described in the April QUARTERLY (Vol. 11, No. 4, p. 342) as being developed at "Greene Park," adjoining Camp Lewis. The great frame hotel now under construction and the annex for the help are to be properly plastered; at least two fire stops are to be provided in the hotel; and the stairways and elevator shafts are to be enclosed. Mr. Bringhurst's contentions regarding the hazards of the buildings already erected were proved by a fire which occurred, probably from spontaneous ignition of some cleaning compound, in a one-story cigar store, 28 feet by 36 feet in area. Two clerks were sleeping in the building, and although the fire started at the other side they had just time, when they were awakened by the heat, to take their clothes in their hands and escape through a window. Eight minutes elapsed before the firemen arrived, the cigar store being then a mass of flames. The roof of a shooting gallery 45 feet distant had also taken fire, but this blaze the firemen were able to extinguish, although in doing so two of them were so severely burned that they had to be taken to hospital. This quick, hot fire happened in a small building on a night when there was practically no wind. It may, however, help the authorities to realize what might happen if one of the large buildings should begin to burn under a stiff breeze.

* * * * *

Hospital Fire Protection. In an interesting editorial comment on the article dealing with fire protection in army hospitals, which we reproduce on another page, *Engineering News-Record* observes that the additional protection obtainable from stucco or hollow tile walls, such as are used in some of the newer

hospitals, was rejected in some instances because army officers considered the cost excessive for the benefit gained and because they were convinced that material and labor were not available for the plastering and masonry work required. Our contemporary states that in the latter opinion the officers were specifically contradicted by the interests promoting the materials, and it expresses the opinion that the controversy might better have been settled by actual test. Its conclusion is to the following effect: "The new hospitals are not fire traps. In all probability they will come through the war without serious mishap, but it remains to be proved that a desirable degree of additional protection could not have been achieved with sufficient speed and economy to warrant its adoption in the later designs."

* * * * *

Flammability of "Dopes" Used on Airplane Wings.

The latest conflict between cheapness and safety is in the matter of the "dopes" or varnishes used on the wings of airplanes to render the fabric taut and waterproof. Two classes of "dope" are now in use, the first class comprising varnishes consisting essentially of a solution of cellulose nitrate or pyroxylin, the second class comprising the varnishes made by dissolving cellulose acetate. According to a paper presented by Gustavus J. Esselen, Jr., before the Northeastern Section of the American Chemical Society:

> The great outstanding difference between the coatings given by cellulose acetate and cellulose nitrate dopes is the inflammability of the latter, a difference which will probably be emphasized more and more as the use of airplanes for peaceful purposes increases. Cellulose acetate dopes leave a non-inflammable finish. The relative behavior of the coatings left by the two types of dope is well illustrated by the fact that some gasoline can be poured on a piece of fabric coated with a good cellulose acetate dope and allowed to burn, and the fabric does not ignite. The same test applied to a pyroxylin-coated cloth results in the immediate ignition of the coating, and in a very short space of time there is nothing left of the fabric or coating but a puff of smoke.
>
> The initial cost of pyroxylin dopes is somewhat less than that of cellulose acetate dopes, and on this account some manufacturers have tried to effect a compromise between expense and inflammability by applying three coats of pyroxylin first, and finishing with two or three coats of acetate. This gives a fire-resisting surface, even though the coating is not non-inflammable all the way through. In Europe only acetate dopes are used, and it seems to me only a matter of time when the users of airplanes in this country will demand that every possible factor of safety be taken advantage of, which will mean the use of a non-inflammable dope.

* * * * *

Chimney Inspection.

The city of Davenport, Iowa, has instituted a thorough inspection of its chimneys. A start was made early in the year in order to give ample time for repairs before the next winter season. According to a report made by the fire commissioner and building commissioner before the inspection was completed, 165 cases had already been discovered in which overhauling or repairs were needed in the interests of safety and efficiency. Davenport deserves great credit for taking this problem so energetically in hand. May many other cities do likewise!

Investigation of Cost of Fire Protective Appliances.

The following bill "Directing the Attorney-General of Massachusetts to investigate certain monopolistic conditions created by the operation of certain laws of the Commonwealth," based on a petition of Edward F. McLaughlin, has been passed by both branches of the Massachusetts Legislature and received the Governor's signature:

RESOLVED, That the attorney-general be directed to investigate whether and to what extent recent building, fire prevention and similar legislation and rules and regulations made under authority of the same have resulted in a forced or artificial demand for apparatus, appliances or devices which, because of patent rights or other reasons, are sold or marketed under monopolistic conditions, or in the absence of competition. The provisions of chapter three hundred and eighteen of the General Acts of nineteen hundred and seventeen are hereby made applicable to this investigation. The attorney-general shall report the result of his investigation, with such recommendations as he may deem advisable, to the general court on or before the first Wednesday in January in the year nineteen hundred and nineteen. For the purposes of carrying out the provisions of this resolve, the attorney-general is hereby authorized to expend a sum not exceeding two thousand dollars, subject to the approval of the governor and council.

* * * * *

Liability for Interference With Water Supply.

A decision of far-reaching effect to municipalities and fire insurance interests of Wisconsin was rendered Wednesday afternoon when the Supreme Court held that a person who interferes with the efficiency of a water system may be held liable in case of damages. The action was brought by an insurance company against the Simmons Company of Kenosha.

This company insured a number of buildings in Kenosha. On October 31, 1916, the buildings and some adjoining ones were destroyed by fire. The insurance company paid the losses due and the owners transferred to the insurance company any rights of action they might have. At the time of the fire Kenosha had a municipal water system, but claims that in the erection of buildings the Simmons Company had pierced some of the pipes, rendering the water system practically useless. It was contended that this left the pipes inadequate to cope with the fire. To this complaint the Simmons Company demurred, and the demurrer was sustained by the lower court, and the insurance company appealed.

The opinion says:

"The theory contended by the defendant and adopted by the trial court that there is no liability shown from the facts stated in the complaint was based upon the rule that under the laws of this State there is no liability either as against the municipality, which has assumed the function of protection against fires by the installing of a water works system and a fire department, or as against any corporation that may be under contract with such municipality to furnish such water supply, for any fire losses due to an entire lack or insufficient supply of water. The same rule is maintained in many other jurisdictions.

This rule, however, which it is not now intended to in any way qualify or limit, does not determine the question that is here involved.

But while such service is being actually rendered by a municipality, as while a fire is going on and an immediate benefit is being received by a householder,

there can be no question but that, as to all third persons, there is then a substantial right and interest in the householder to such service, which carries with it the further right to be protected against its invasion by third persons. At the moment such a right comes into existence there springs up at the same time a corresponding duty on the part of third persons not to unlawfully interfere therewith. For a breach of such duty by third persons there is a corresponding liability. This is recognized in many cases.

We see no good reason why this rule should not be carried one step further and as applied to the facts stated in this complaint require us to hold as we now do that so long as the householder or inhabitant of the city is in the position to receive, and the municipality is ready and willing to continue such service, the person who interferes with such relationship between the municipality and its inhabitant and thereby causes injury to such householder or inhabitant must respond for such damages as may be directly traceable to his interference as a proximate cause. It is not for a person who has interfered with such existing right or privilege to say that it is a mere gratuity on the part of the municipality or that the municipality cannot be compelled to continue such service or be held responsible for failure to do so. So long as the municipality is ready and willing to continue and the householder or resident to accept the benefit of such a water system service, the unlawful interruption thereof by a third person and consequent damage is a wrong for which the law affords a remedy.

Therefore, if it shall appear from the evidence that defendant's negligence so interfered with or interrupted the service which the municipality had been rendering and was ready and willing on its part to continue to render to the householder whose house was destroyed by fire that it could properly be held the proximate cause of the loss of the dwelling, we see no reason why the defendant should not respond in damages. It follows therefrom that the demurrer to the complaint was improperly overruled."

* * * * *

Liability for Insufficient Water Supply.

Not so cheering, from the fire protection standpoint, as that quoted above is a decision reported from North Carolina (Howland *vs.* City of Asheville, 94 Southeastern Reporter 524). In that case the plaintiff endeavored to recover damages from the municipality in respect of failure to furnish water mains of sufficient size to afford adequate fire protection. The Court said:

"The defendant is not liable in such cases, because it is performing the functions of government, where the whole community is affected in the same way, though not all perhaps in the same degree, and is not performing an act of a business nature for its own benefit. * * * In this case there was no statutory liability imposed on the defendant, and no special contract with the plaintiff, as she was being served just as were other citizens of the same community, there being no extra charge made to any of them for the use of water at fires, if such a payment would make any difference, which we do not decide, as it is not necessary to do so. The fire department was intended for the common benefit and protection, and was maintained at public expense. There is no view of the facts disclosed by this record which would justify a recovery by the plaintiff."

* * * * *

Smoking in Garages.

Fire Prevention Commissioner Frank Lewis of the Metropolitan District, Boston, has set an example that might well be copied on a large scale in attempting really to suppress the practice of smoking in garages. Such smoking had already been prohibited, but realizing that the regulations were constantly disregarded and that their enforcement could

not safely be left to the public spirit of owners and users of garages, Mr. Lewis arranged a conference with the head of the Boston Police Department, with the result that a general order was promulgated in every police station in the city, instructing the officers to summon into court all persons indulging in the forbidden practice. Letters were then written to the other chiefs of police in the Metropolitan District and also to the clerks of court with the object of facilitating proceedings when officers applied for summonses. It is quite certain that vigorous administrative action along these lines is urgently needed almost everywhere if smoking in garages is to be stopped.

* * * * *

New Method of Investigating Fire Causes.

With the object of overcoming as far as possible the difficulty hitherto experienced in obtaining convictions for arson and kindred crimes, owing to the destruction of direct evidence by the fire, a new system under which six inspectors are detailed for investigation work alone has been inaugurated by the Chicago Bureau of Fire Prevention and Publjc Safety, Chief John C. McDonnell (Member N. F. P. A.). The work of these investigators is thus described in *The American City* by member C. W. Hejda, Chief Engineer of the Bureau:

> The men are distributed at the various Squad Companies, and work in two shifts, one day and one night. They respond with the Squad Companies to all alarms. They are not required to perform any fire duties, and devote their entire time to investigations.
>
> Arriving at a fire, their first duty is to determine the cause, and make such other observations as may be necessary. Should the fire be of suspicious origin, the inspectors collect all available evidence and question the various persons interested, thus getting their statements before they have the opportunity to "frame" a plausible story. This information is then reported to the Fire Attorney and the State Fire Marshal, who take charge of the cases at that point.
>
> Another good feature of this work is the correction of defective conditions which exist in buildings where fires occur. Take, for example, a fire caused by a defective flue. The investigator informs the Bureau of the conditions, and the district inspector supervises the necessary improvements.

Although the system is only in the experimental stage, Mr. Hejda says that its results have so far been very encouraging, and its moral effect is traceable in a diminution in the number of "suspicious" fires.

* * * * *

What are Automatic Sprinklers For?

Fire prevention engineers have long been in the habit of joking about the idea entertained by some property owners that the sole purpose of installing sprinklers and other fire-protective appliances is to save money on insurance premiums. During recent months, however, the matter has become very serious, and the latest manifestation of insensibility to the obligation resting upon all property owners to do everything in reason to safeguard buildings and contents against destruction by fire seems not unlikely to result in action by the Federal Government. Not being able to obtain free insurance against damage from sprinkler leakage, the proprietors of certain warehouses used for the storage of wool on the

Boston waterfront consider the present a suitable time to employ labor and money in dismantling and removing a sprinkler equipment. It is difficult to find suitable language in which to characterize such action, but at least the incident vividly illustrates the fact that the installation of fire-protective devices is not necessarily evidence of an awakened fire prevention conscience.

* * * * *

Fire Department Quarters. Member Alexander Inch, of Winnipeg, contributes a timely note on the accommodations provided for firemen in the large departments of England and Scotland, with the conditions in which he is familiar. The recent troubles in the fire service of Western Canada have impressed strongly upon him the wisdom of the British system of making suitable provision for the housing of the married men, in addition to permanent quarters for single men, in connection with the fire stations in all the large cities. He points out that this system enables the firemen to make a real home in the fire service, and simplifies matters of discipline and control. In the larger stations ample drill yards and facilities for gymnastic work are available, and a billiard table is now considered a requirement of a modern station. In the city of Glasgow and its extended divisions each station is provided with a suitable recreation room.

* * * * *

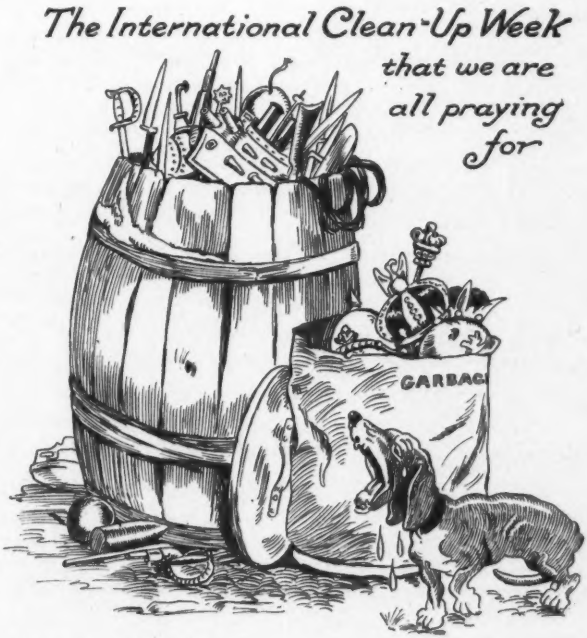
Unusual Chlorate Fire. In view of the attention given elsewhere in this issue to "the chlorates," particular interest attaches to a fire recently reported by member C. Albert Gasser of the Bureau of Combustibles and Fire Risks, Newark, N. J. A barrel filled with small iron parts burst into flame in the shipping room of a rivet factory. A crackling noise accompanied the flames. Investigation showed that the barrel was one of a number obtained from a local firm of barrel dealers, and that it had originally contained chlorate of soda. There had been more than one fire of unexplained origin on the barrel dealers' premises, and experiments were therefore made with parts of barrels taken from this lot. The results indicated that there was considerable likelihood of spontaneous ignition where the wood had been impregnated with chlorate of soda, and a warning was issued against dealing in barrels so impregnated.

* * * * *

Static Electricity and Gasoline. Member Anson Murphy of St. Louis, Chief Inspector for W. H. Markham & Co., sends us an interesting note on the possibility of fire at filling-tanks of automobile trucks. Static electricity from pouring gasoline through strainers is recognized and guarded against, but the hazard related by Mr. Murphy is from another cause.

On two occasions the Pierce Oil Corporation of St. Louis experienced an ignition of gasoline vapor while loading from storage tanks—tanks mounted on trucks. The cause was at first mysterious, but was

finally discovered. As the truck wheels were rubber-tired, the static charge, produced possibly by the centrifugal action of the balance wheel in the motor and the belt driving the fan, accumulated in the machine, and when the nipple from the loading-pipe leading from the storage tank touched the flange on the motor tank it formed a "ground," causing an arc at the point of contact, which ignited the vapor. Mr. J. Will Finlay, Superintendent of the Pierce Oil Corporation says that to overcome this hazard a chain was attached to the rear axle of the truck, long enough to drag upon the ground to relieve the static accumulation, since when no trouble from this source has been experienced.



Courtesy of Whittlings.

Meeting of Executive Committee.

The usual meeting of the executives following the annual meeting of the Association was held in New York City on June 26th for consideration of matters referred to the committee by the Association, for revising the rosters of the various committees where necessary and for consideration of reports, finances, communications, etc. The following members were present:—

H. L. Phillips, Hartford, *Chairman.*
Gorham Dana, Boston.
Rudolph P. Miller, New York.
C. L. Scofield, Montreal.
A. R. Small, Chicago.
Sidney J. Williams, Chicago.
Ira H. Woolson, New York.
F. J. T. Stewart, New York, *President.*
Charles E. Meek, New York, *Past-president.*
Franklin H. Wentworth, *Secretary-Treasurer.*

In addition to the usual routine, the following items of business were considered and action taken as indicated:

The *23rd annual meeting* of the Association was set for May 6, 7, 8, 1919, in New York City.

A *Program Committee* for the annual meeting was appointed, consisting of the President, Secretary, Chairman of the Executive Committee and the President and Secretary of New York Chapter, N. F. P. A.

Mr. H. L. Phillips of Hartford and Mr. A. R. Small of Chicago were appointed to complete the *Nominating Committee for 1919.*

The *Budget* submitted by the Treasurer was *approved.*

The matter of the report of the special Committee on Commercial Status of Automatic Sprinkler Installation was *laid upon the table.*

The amended report of the Committee on Roof Openings and Cornices was *adopted.*

The section of the report of the Committee on Explosives and Combustibles covering *Regulations for Household Use of Kerosene and Fuel Oil* was *referred* to the Committee on Inflammable Liquids for further consideration.

The amended report of the *Committee on Safety to Life,* with additional changes submitted by member Sidney J. Williams, was *approved.*

The matter of the method of listing members' names in the *Year Book* was left to the Secretary.

A communication from the Bureau of Standards U. S. respecting the incorporation of *specifications for safety to life* in the *National*

Electrical Code (fire) was *referred* to the Electrical Committee for consideration and report.

The matter of a suggested speaking campaign on Fire Prevention in New York theatres was favorably regarded and was *referred* to the New York Chapter for consideration.

A communication from the National Safety Council respecting the issuance of fire prevention bulletins by that body was favorably considered and *referred* to the Secretary.

The matter of a campaign to abolish the manufacture and use of the *nitro-cellulose motion picture film* was *referred* to the Committee on Public Information for favorable consideration.

The matter of *dust removal* from factories manufacturing Explosives was *referred* to the Committee on Hazardous Chemicals and Explosives.

A *special committee* consisting of President Stewart, Chairman Phillips of the Executive Committee and Edward A. Barrier, Chairman of the Committee on Inflammable Liquids, was appointed to confer with the National Paint, Oil and Varnish Association regarding the *adoption of a tester for ascertaining the flash point* of inflammable liquids.

The matter of preparing performance and installation requirements for *concrete oil tanks* was *referred* to the Committee on Inflammable Liquids for consideration and report.

The Committee on Explosives and Combustibles was replaced by three committees: (1) Gases; (2) Inflammable Liquids; (3) Hazardous Chemicals and Explosives.

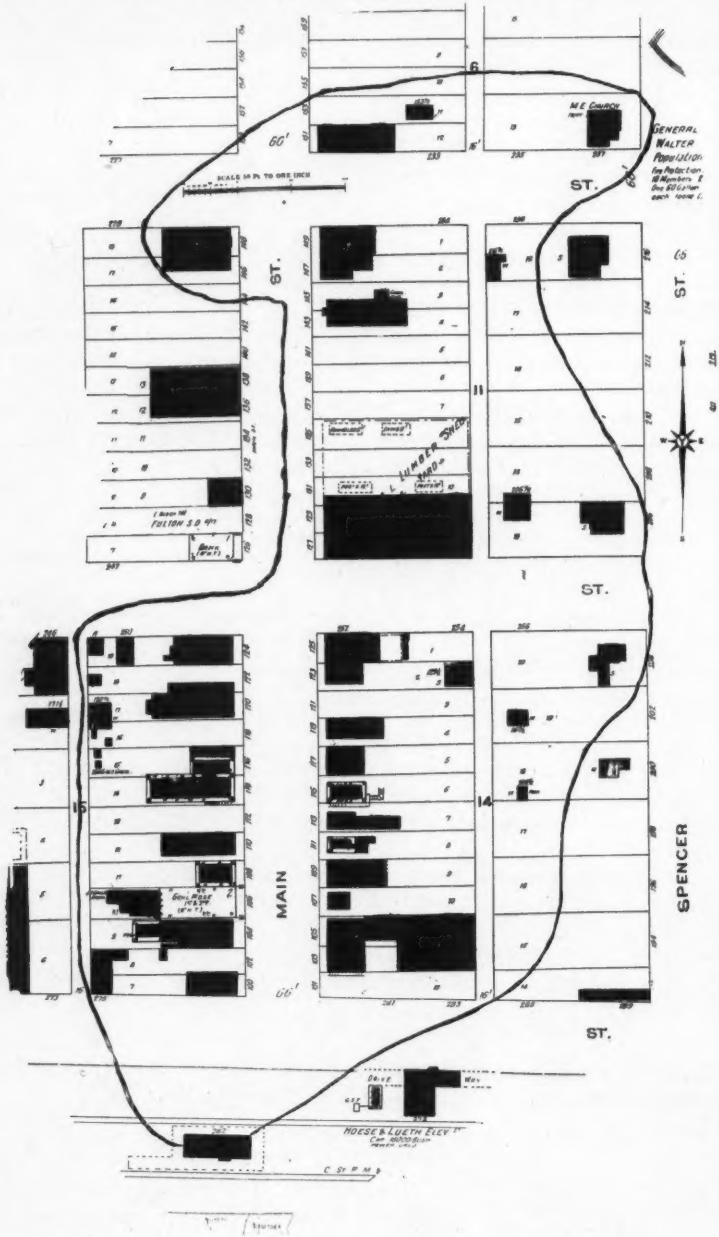
The matter of the recommendation of the Underwriters' Laboratories' Industry Conference on Wires and Cables, that the enforcement of Rule 26a of the National Electrical Code in so far as it requires the marking of wires and cables by the manufacturers be indefinitely suspended because of present abnormal industrial conditions, was *referred* to the Electrical Committee for consideration and report to the Executive Committee.

In consideration of the present large membership of the *Committee on Automatic Sprinklers,* the Chairman of the Committee was directed to drop from the committee any members not active in the committee work during the present fiscal year.

The following committees were suspended:

(1) High Value Districts.
(2) Vestibule Fire Stops.

All other committees were continued and changes in the membership thereof, if any, will be shown in the forthcoming Year Book.



Map of Fulton Conflagration. Heavy black line shows boundary of main conflagration area.

Shingle Roof Conflagration at Fulton, S. D.

Through the kindness of member Charles J. Lund, of Minneapolis, we are able to reproduce the instructive map, which appears on the opposite page, showing how shingle roofs and frame construction facilitated the destruction on May 16, 1918, of some thirty buildings in the business section of Fulton, South Dakota. Although the greater part of the damage occurred in the area included within the heavy line on the map, a number of dwellings beyond were burned or damaged. In fact, the third building to take fire was a residence far outside the line, five blocks northeast of the depot in which the fire started.

The exact cause of the fire is not known. At about 2.50 p. m. a passerby discovered fire under the platform on the south side of the railway depot, and at once gave an alarm. It is possible that a locomotive spark from a freight train which had passed some 20 minutes previously was responsible, but there were a number of men, at least one of whom was smoking, lounging around the platform at the time. Before crowbars or engines could be brought to the scene, the flames had secured a good hold on the depot, quickly reaching the shingle roof, from which burning brands were caught by the gale that happened to be blowing, and were driven all over the town. The second building to be involved was a block north of the depot, and buildings Nos. 123 and 125 in Block 14 were a mass of flames before No. 100 on Lot 7, Block 15, commenced to burn.

It was immediately recognized that the fire was beyond control, but a large crowd kept carrying water and working to save property. Parts of several stocks of goods were saved, as were also some household belongings. On the whole, however, the salvage was small. There was a volunteer fire department with an equipment of two chemical engines. The fire was all over in two hours.

All the buildings destroyed, with the exception of No. 106, Block 15, which was brick-veneered, were frame construction. The three unburned buildings on the left side of Main Street all had asphalt roof coverings. It is also worthy of note that one of them, the bank at the corner, was a brick structure.

THE SHINGLE ROOF IN CHINA.

The exposure hazard is eliminated by having practically one roof for the whole city!

Report of Fire Prevention Section, War Industries Board, U. S.

Under date of July 1st, Chairman W. H. Merrill of the Fire Prevention Section has issued a brief report covering the work of the Section to date. The items of the report are as follows:—

1. This Section was organized on April 5th, first report issued April 11th.

2. Our work to date has covered 380 munition plants having large Government contracts. These we have classified according to their qualities as fire risks as follows:

Good or no action required	216
Fair	60
Poor	59
Bad	45
Total	380

3. Our recommendations have been presented through War and Navy Department channels, as a result of which improvements are reported completed or in progress on 24 plants covered in reports sent out between April 11th and June 18th. These improvements include: Installation and extension of sprinkler protection; extension of yard pipe, hydrant and hose systems; increase in water supplies; storage safeguards; fire cut-offs; additions to watch services; additional first aid appliances; improvement in electric wiring; protection for openings in fire walls; minor changes in building construction; substitution of metal for wooden partitions, cupboards and lockers; enforcement of rules prohibiting smoking; new for old sprinklers and improved housekeeping.

4. Reports on additional plants at present in progress, 29.

5. Reports on additional plants ordered, 162.

6. Matters of Policy Taken Up:
   (a) Fire prevention clauses for Government contracts.
   (b) Definition of Government policy in respect to financing improvements for fire protection.
   (c) Lag of two to four weeks in routing reports through present prescribed channels.

7. *Co-operating Committee,* representing seven other departments of the Government.

Eleven meetings of this Committee have been held; minutes are on file. Our program calls for weekly meeting at 3 p. m. on Tuesdays.

8. *Advisory Committee*: Four meetings of this Committee have been held in New York; minutes are on file. Our program calls for evening meetings of this Committee in New York the last Wednesday of each month.

9. *War Industries Board Section Chiefs*: Our program calls for attendance at meetings of War Industries Board Section Chiefs on Mondays and Wednesdays.

10. *Expert Service*: We have thus far been represented at conferences and furnished expert advice on matters of major importance on requests received from thirty-seven Departments, Bureaus and Divisions of the Government.

11. *Certificates of Information*: 5,816 Certificates of Information covering insurance inspectors have been received, sorted, filed and indexed for use by Intelligence Departments of the Government.

Changes have been made in the Advisory Committee which now has Mr. Henry Evans as Chairman, and a number of engineers have been added to the staff of the Executive Committee; men well known in the membership of the N. F. P. A. Following is a corrected roster as of July 1st of the Executive Committee, the Department Co-operating Committee, and the Advisory Committee:

Executive Committee.

W. H. MERRILL, *Chairman.*

Frank L. Pierce — W. E. Mallalieu

George W. Booth, Charles H. Smith — Secretaries and Associate Chiefs of Section.

Engineers:

John C. Hawley	Percy D. C. Steward
Frank W. Eames	L. K. Davis
C. W. Pierce	Leslie D. Wood
William D. Milne	R. L. Rumbaugh
A. J. Meyer	E. D. Wood
George L. W. Goodwillie	W. L. Lee

W. G. Bayliss

A. O. Boniface, Fire Appliance Expert

Jerome Steinert, Chief Clerk

Co-operating Committee.

W. H. MERRILL, *Chairman*

Treasury Department—Honorable Thomas B. Love, Assistant Secretary.

War Department—Colonel Marlborough Churchill, Chief of the Military Intelligence Branch.

Navy Department—Captain Roger Welles, Director of Naval Intelligence, and Lieut. W. L. Todd.

Department of Justice—Mr. A. T. Geisler.

Shipping Board—Mr. Hendon Chubb.

Food Administration—Mr. Edgar Rickard.

Labor Department—Bureau of Industrial Housing and Transportation—Mr. B. L. Fenner and Mr. C. W. Mercer.

Advisory Committee.

HENRY EVANS, New York, N. Y., *Chairman.*

R. M. Bissell, Hartford, Conn.	C. A. McCotter, Indianapolis, Ind.
F. C. Buswell, New York, N. Y.	C. G. Smith, New York, N. Y.
John R. Freeman, Providence, R. I.	S. Y. Tupper, Atlanta, Georgia.
John Marshall, Jr., Chicago, Ill.	L. R. Welch, Fitchburg, Mass.

W. E. Mallalieu, *Secretary.*

An Excursion into Fire Protection History.

Courtesy of Fire and Water Engineering.

The decline of learning was accompanied with a decay in all the useful and ornamental arts; some of these have disappeared altogether, and have never been recovered, so that the attainments of the ancients in them have perished.

Fire engines were nearly or altogether forgotten in the Middle Ages; portable syringes seem to have been the only contrivances, except buckets, for throwing water on fires, and from their inefficiency and other causes, their employment was very limited. The general ignorance which then pervaded Europe not only prevented the establishment of better instruments, but the superstitions of the times actually discouraged their use. There is not a more singular fact in the history of the human mind than that the religion, doctrines and opinions of a large portion of mankind should have in every age produced the most deplorable results with regard to conflagrations. The Parsees, Ghebres, etc., of Asia, and other religious sects which have subsisted from the remotest ages, never willingly throw water upon fires. They consider it criminal to quench fire, no matter how disastrous the result may be. They would rather perish in it than thus extinguish the emblem of the Deity they worship. They would sooner be persuaded to pour on oil to increase than water to assuage the flame. Among such people fire engines, of course, were never used. Another uneducated part of the human race, though entertaining no such reverence for fire, is so far influenced by the pernicious doctrine of fatalism, as to make little or no efforts to suppress it.

These people look upon fires as the act of God, determined by Him, and therefore conclude it useless to contend with Him in attempting to extinguish that which He has kindled. Hence the proverbial indifference of Mohammedans in the midst of conflagrations. What Toreen has said of Surat in particular is applicable to every city of Asia and of the East. "Many fine buildings have been destroyed by fire, which, according to the Mohammedan doctrine of predestination, it is in vain to withstand." Of the Chinese, Mr. Davis remarks: "The foolish notion of fatalism which prevails among the people makes them singularly careless as regards fire, and the frequent occurrence of accidents has no effect upon them, although the fearful conflagration of 1822 went far to destroy the whole city (Canton)."

The miserable delusions of ecclesiastics in Europe during the Middle Ages were quite as preposterous and equally effective in paralyzing the energies of the people. It was a common belief that

fires and various other calamities were induced by wicked spirits, and that the best mode of removing the evils was by driving the authors of them away. These intangible workers of mischief, according to the demonologists of the times, consisted of numerous classes, and the labors of each were confined to certain elements. It was those who roamed in the air that were the greatest incendiaries. When a house, therefore, was on fire, the priests, instead of stimulating by their example the bystanders to exert themselves in obtaining water, etc., had recourse to the images and pretended relics of saints which they brought out of the churches in order to exert their influence in stopping the progress of the flames and expelling the invisible authors of them. The pall, or sacred covering of the altar, was also frequently carried in procession to contribute to the overthrow of the fiends. But when a church itself took fire, the people then heartily blasphemed the saint to whom it was dedicated for not preventing the mischief.

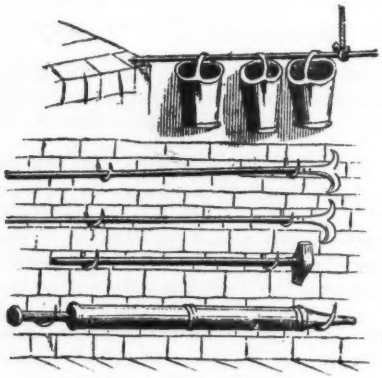


Fig. 1. Earliest known sketch of fire-extinguishing apparatus.

The oldest sketch of a complete set of apparatus for extinguishing fire unearthed is in a cut representing the interior of a laboratory or smelting furnace in the De Re Metallica of Agricola. The implements are: a syringe, a sledge hammer, two fire hooks and three earthen buckets conveniently arranged against a wall. (See Fig. 1.) The syringe was made of brass. In these figures is shown all that was preserved through the Middle Ages of ancient firemen's machinery: the engine of Heron seems to have been forgotten. Indeed, the syringe itself was not generally used in Europe till late, for it was not till the close of the 16th century that "hand squirts," as they were named, were introduced into London. Previous to that time a watchman, buckets, hooks and ladders only were in use.

The owners of houses, or chimneys that took fire were fined, and men were appointed to watch for fires and give the alarm.

In 1472 a night bellman was employed in Exeter to alarm the inhabitants in case of fire, and in 1558 leathern buckets, ladders and crooks were ordered to be provided for the same city; no application of the pump seems to have been thought of.

Syringes continued to be used in London till the latter part of the 17th century, when they were superseded by more perfect machines. An account of them and the mode of working them would make a modern fireman smile. They were usually made of brass and held from two to four quarts. The smaller ones were about two feet

and a half long and an inch and a half in diameter, the bore of the nozzles being half an inch. Three men were required to work each, which they achieved in this manner: two, one on each side, grasped the cylinder with one hand, the nozzle with the other, while the third one worked the piston. Those who held the instrument plunged the nozzle into a vessel of water, the operator then drew back the piston and thus charged the cylinder, and when it was raised by the bearers and in the required position he pushed in the piston and forced, or rather endeavored to force, the contents on the fire. We are told that some of these syringes are preserved in one or two of the parish churches. It can excite no surprise that London should have been almost wholly destroyed in the great fire of 1666, when such were the machines upon which the inhabitants chiefly depended for protecting their property and dwellings. If the diminutive size of these instruments be considered, the number of hands required to work each, besides others carrying water and vessels for them, the difficulty and often impossibility of approaching sufficiently near to reach the flames with the jet, also the loss of part of the stream at the beginning and end of each of the pistons, the whole act appears rather as a farce, or the gambols of overgrown boys at play, than as the deliberate effort of men to check the fire.

In Asia syringes have probably been always in limited use. They are the only instruments of the pump kind now known there, if China be excepted. Very effective engines on the European plan were made by the Chinese.

The fire engine of the Turks is an improvement on the syringe, but not much more effective. The author of "Sketches of Turkey" observes, when speaking of fire in Constantinople: "Indeed, when we afterwards saw the machines used by the Turks to extinguish fires, we were not surprised at the feeble resistance which they could oppose to the progress of the devouring element. The engines, in fact, are not larger than those employed with us to water gardens. They have but a single chamber, which is about eight inches long by three or four in diameter.

"When an alarm of fire is given, a man seizes one, another brings a skin of water, pours it into the reservoir, and they pump away. Sandys, in the beginning of the 7th century, visited Constantinople, and speaks of the frequency of fires in that city. He observes: 'It is not to be marveled at, for the citizens dare not quench the fire that burneth their own houses because officers are appointed for that purpose.'"

When the useful arts began to excite attention, the defects of portable syringes were too apparent to be neglected, hence in the early part of the 16th century several attempts were made to remedy them by those noble spirits who burst through the prejudice that had so long consigned the subject of practical mechanics to the mere makers of machines as one unworthy of a philosopher's pursuit. To render the syringe an efficient fire engine would seem to be impossible except by converting it into a forcing pump, and in that case it would be no longer a syringe. As long, therefore, as such an idea did not occur to engineers, they had no resource but to improve the

"squirt" as well as they could, and however hopeless the task may now appear, it was not only attempted, but, to a certain extent, accomplished, and with considerable ingenuity, too, as will appear from Fig. 2. It is described in Besson's "Theatre," and must, therefore, have been invented previous to 1568, the date of the permission to print his work.

In this engine several defects of the hand "squirts" are avoided: as the necessity of inverting the instrument to refill it by plunging the nozzle into the vessel of water, the small quantity contained in the former, and the consequently incessant repetition of the operation and interruption of the jet and the difficulty of directing it on the flames with certainty or precision. Besson (if he was the inventor), therefore greatly enlarged the capacity of the cylinder, making it sufficient to contain a barrel or more, and, as a matter of necessity, placed it on a carriage. To eject the water uniformly, he removed the piston by a screw; and when the cylinder was emptied, it was refilled through the funnel by an attendant, as the piston was drawn back by reversing the motion of the crank. When recharged, the stop cock in the pipe of the funnel was closed and the liquid forced out as before. As flexible pipes of leather (hose) the "ball and socket" and "gooseneck" joints had not been introduced, some mode of changing the direction of the jet of this enormous syringe was necessary. To effect this, it is represented as suspended on pivots, which rest in two upright posts.

A number of holes are made in each, and are so arranged as to be opposite each other. A bolt is passed through two of these, and also through a similar hole in a piece of metal that is firmly secured to the upper part of the open end of the cylinder; and thus holds the latter in any position required. The iron frame to which the female part of the screw is attached, is made fast to the cylinder and it is through a projecting piece on the end of this frame that the bolt is passed. By these means any elevation could be given to the nozzle, and the syringe could be secured by passing the bolt through the piece just mentioned and through the corresponding holes in the straps. When a lateral change in the jet was required the whole machine was moved by a man at the end of the pole as in the figure. To the frame, jointed feet were attached which were let down when the engine was at work. The women represented (one only is given in the figure) remind us of a remark by Fosbroke: "In the middle ages during fires women used to fetch water in brazen pails to assist." Considering the age when this engine was devised and the object intended to be accomplished by it, it certainly has the merit of ingenuity as well as originality. It will be obvious to every practical mechanic that engines of this kind of large dimensions must have been at best but poor affairs. To make the piston work sufficiently accurate and tight, and to keep it so, must have been a work of no small difficulty.

The Germans were proverbially in advance of the rest of Europe in the 15th, 16th and 17th centuries, in almost every department of the arts. "The excellency of these people (observes Heylin in his Cosmography) lieth in the mechanic part of learning, as being emi-

nent for many mathematical experiments, strange water works, medicinal extractions, chemistry, the art of printing and inventions of like noble nature, to be no less benefit than admiration of the world." As early as A. D. 1518, some kind of fire engines were used in Augsburg, being mentioned in the building accounts of that city. They were named "instruments for fire," and "water syringes useful at fires." Their particular construction is unknown; but from a remark in the accounts respecting wheels and poles, they are supposed to have been placed on carriages. They were probably large syringes and mounted like the one represented in the last figure.

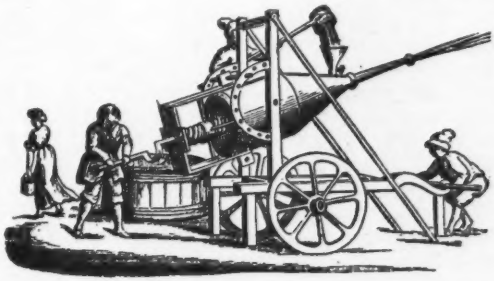


Fig. 2. "Besson's" Fire Engine.

The oldest pump engines of modern times were certainly made in Germany and about the close of the 16th or beginning of the next century.

The first one noted is that of Hautsch, in 1656. In giving an account of it, Schottus remarks that the invention was not then new, it being known in other cities, and he, himself, remembered having seen a small one in his native city (Konigshofen) forty years before, consequently about 1617. There is a book published in 1615, which contains a figure and description of a German engine of that time, and which furnishes the information desired. This book is the "Forcible Movements" of Decaus.

This machine is named "A rare and necessary engine by which you may give great relief to houses that are on fire." Below is given the whole of the explanation: "This engine is much practical in Germany and it hath been seen what great and ready help it may bring; for although the fire be 40 feet high, the said engine shall there cast its water by help of a lever, or five men lifting up and putting down a long handle, in form of a lever where the handle of the pump is fastened; the said pump is easily understood; there are two suckers (valves) within it, one below to open when the handle is lifted up and to shut when it is put down; and another to open to let out the water; and at the end of the said engine there is a man which holds the copper pipe, turning it to and again to the place where the fire shall be." In other words, this was a single forcing pump, such as shown in Fig. 3 and secured in a tub. For the convenience of transportation the whole was placed on a sled, and dragged to a fire by ropes.

The bore of the forcing pipe seems to have been small compared with that of the pump cylinder, a circumstance combined with the

long lever and the elevation of the jet. This machine exhibits a decided improvement on the primitive syringe, and constitutes a great step towards the modern engine. In the short angular tube to which the jet pipe is attached is introduced the germ of the more valuable deck pipe.

Notwithstanding the superiority of pump engines over the syringes many years elapsed before they were generally adopted. "The English (observes a British writer) appear to have been unacquainted with the progress made by the German engineers; or to have been very slow in availing themselves of their discoveries, for at the close of the 16th century "hand squirts" were first introduced in London for extinguishing fires; and it was not till the beginning of the next, that they began to place them in portable and larger reservoirs. When placed in the latter and worked by a lever the engines thus obtained were considered a great mechanical achievement; for when in 1633, three of them were taken to extinguish a large fire on London bridge, they were considered "such excellent things, that nothing that was ever devised would do so much good. Yet none of them prospered, for they were all broken." The observation that "hand squirts" or syringes were placed in reservoirs and then worked by a lever is not strictly correct; they were small forcing pumps that were employed.

But the fire engine as thus improved had still many imperfections. The water was projected in spurts as from a syringe. The jet not only ceased with the stroke of the piston, but a portion of the water was in consequence lost by falling between the fire and engine at the termination of each stroke. An obvious mode of rendering the jet constant was by connecting two pumps to one discharging pipe (as the figure of Heron's) and working the pistons alternately either by a double lever or two single ones. This was first adopted by the old German engineers. Such appear to have been the best fire engines in England when the great fire in London occurred in 1666. They are referred to in the official account of the fire, dated Whitehall, September 8 of the same year. "This lamentable fire in a short time became too big to be managed by any engines." But nothing can show their general inefficiency in a stronger light than the measures adopted by the city government the following year to guard against a similar calamity. Instead of relying upon engines, they seem to have retained their confidence in the old syringe.

"1. By an act of the Common Council, the city was divided into four districts, and each thereof was to be provided with eight hundred leathern buckets—fifty ladders, of different sizes, from twelve to forty-two feet in length—two brazen hand squirts to each parish, four and twenty pick ax sledges, and forty shod shovels.

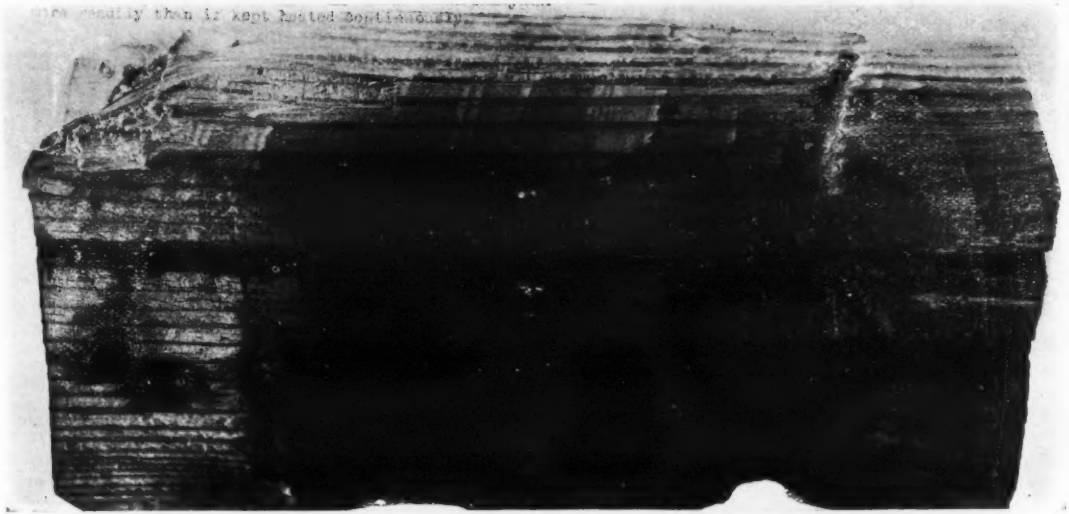
"2. That each of the twelve companies provide themselves with an engine, thirty buckets, three ladders, six pick ax sledges, and two hand squirts; to be ready upon all occasions. And the interior companies such a number of small engines and buckets as should be allowed them by the Lord Mayor and Court of Aldermen.

Fig. 3. Early type of pumping engine.

"3. That the Aldermen passed the office of Shrievalty, do provide their several houses with four-and-twenty buckets, and one hand squirt each; and those who have not served that office twelve buckets and one hand squirt each.

"4. And for the effectual supplying the engines and squirts with water, pumps were to be placed in all wells; and fire plugs in the several main pipes belonging to the New River and Thames Water Works."

Small or hand engines continued to be employed in London in the 18th century. This appears from a law, passed in the 6th year of Queen Anne's reign, by which it was enacted that "each parish shall keep a large engine, and an hand engine, and a leather pipe, and socket of the same size as the plug or fire cock (of the water mains), that the socket may be put into the pipe to convey the water clear to the engine," under a penalty of ten pounds. In case of a fire, the first person who arrived with a parish engine to extinguish it was entitled to thirty shillings, the second twenty and the third ten, provided the engines were in good order, "with a socket or hose, or leather pipe." The following year, the owners or keepers of "other large engines," (not parish engines), were entitled to the same reward upon arriving with them and assisting in extinguishing a fire.



CHARRING OF WOODEN SUPPORT BY STEAM COIL.

Member Geo. W. Stone of Niagara Falls, N. Y. sends the picture reproduced above. It shows a piece of wood to which a steam coil was attached by pipe clips. The coil was in this position for two or three winters with the result that the wood became badly charred. The charring was discovered through a special inspection in search of hazardous conditions.

Loss of Life from Common Hazards, IV.

Since the publication in the January QUARTERLY of the third article in this series two frightful holocausts have occurred involving the sick and helpless. Details of one of these—the fire at the Central State Hospital, Norman, Okla., on April 13, 1918,—are given in a report of the Oklahoma Inspection Bureau appearing on another page. For particulars of the disaster which snuffed out more than fifty little lives in the Grey Nuns' Home at Montreal we are dependent upon press reports. The following account is taken from the *Municipal Journal* of February 23, 1918:

Fifty Children Die in Fire.

MONTREAL, QUE.—More than fifty children perished in a night fire which partially destroyed a wing of the Grey Nuns' Home here. The home is a great building, occupying a whole block, and part of it is occupied by convalescent soldiers. Although many of them were stretcher cases, all adults were taken out of the building without loss of life. Several of the returned wounded men were seriously injured by falling debris before they could be reached by the large army of rescuers. A dozen or more had to be carried from the second and third stories on beds. There were about one thousand persons in the building—200 returned soldiers, many nursing sisters, nuns, crippled people, aged and children. The fire started on the top floor, near the tower, and immediately caught in the curtains of a nearby window, from which it spread rapidly throughout the wooden interior. All of the top floor was occupied by babes in cots, some of them only a few days old. These were the infants lost, all the older children, who were in another part of the building, being saved. When the firemen had, after valiant work, got the fire under control, all the southern part of the top story had been destroyed and a great deal of damage done to the remaining part of the west wing. The returned soldiers who were not confined to their beds lent their efforts to the rescue work. When the first fireman arrived the soldiers were already at work, at great risk to themselves, in handing children down the fire-escapes. Nearly the whole upper floor was then ablaze. The firemen rushed in and seized children right and left. A sudden gust of flame and smoke which burst from the tower made it impossible to reach children still lying in their cots in that part of the building, but only upon the definite orders of the fire chief were the soldiers debarred from attempting further rescues.

The fact that wounded soldiers were involved, several of whom were seriously injured by falling debris, is a concrete illustration of the need for earnest thought upon the problem of safeguarding army hospitals referred to elsewhere in this issue.

There is a long tale of lesser horrors. These are divided into classes for the purpose of bringing into clear relief the frequency with which certain kinds of recklessness result in the destruction of human life.

Children and Matches — 8 Deaths.

PROVIDENCE, R. I., Dec. 3.—When Mrs. Myles Brooks returned home at 9 a. m., after taking her little son, William, to school, she found the baby, Joseph, aged 2 years, lying on the floor near his crib in the kitchen with his night clothes

burned off. He died in the Rhode Island Hospital. The mother thinks he was playing with matches.

SOMERVILLE, MASS., Dec. 3.—Frances Tadia, infant daughter of Mr. and Mrs. Daniel Tadia, who was just a year old today, received fatal burns at 11 o'clock this morning at the home of her parents, 693 Somerville Ave., Somerville. The child was one of four children of Mr. and Mrs. Tadia, who obtained matches in the kitchen of their home on the top floor of the six-apartment house, and lighted several. One of the lighted matches ignited the thin clothing of the baby, who was playing about the floor.

ARLINGTON, MASS., Dec. 15.—John Flynn, 4-year-old son of Mr. and Mrs. Bartholomew Flynn of 22 Bacon Street, died in hospital this afternoon from burns received at his home this noon.

The boy, with another child, was left in the house by his mother, who went out for a few minutes on an errand. Screams of the children attracted her attention and she rushed back to find her boy a mass of flames. She rushed outdoors with him and rolled him in the snow, extinguishing the flames.

It is supposed that the child got hold of a match and lighted it, igniting his blouse.

WARE, MASS., Dec. 17.—While attempting to extinguish a fire set by her baby brother, who was playing with matches and paper, Gladys Babcock, aged 8, set fire to her own clothing today and received burns from which it is said she cannot recover.

PORTSMOUTH, N. H., Dec. 17.—David Smith, the 5-year-old son of Mr. and Mrs. Joseph Smith, is dying today in the Portsmouth Hospital from burns. The boy was playing with matches while his mother was away for a few minutes, and upon her return she found him on the floor, his clothes in charred rags.

SAN FRANCISCO, CAL., Jan. 1.—Claire McCormick, 768 Cole Street, a 13-year-old girl, died yesterday morning at Morton's Sanitarium from burns sustained the night before, when her night clothing caught on fire.

The child had lighted a match to look at a clock. The match caught her night clothing and burned her body and face.

SAN FRANCISCO, CAL., Feb. 28.—Raymond Silvas, four years old, died yesterday in the San Francisco Hospital from burns received while playing with matches several days ago.

BOSTON, MASS., Apr. 11.—In the absence of their mother, two children about four and five years old, played with matches. A lace curtain caught fire, and soon the apartment was filled with flames. The elder children, frightened by what had happened, ran to the street, leaving the baby on a bed.

One stream of water, guided by the first fireman to arrive, extinguished the fire, and under the bed they found the body of the infant. Apparently he had fallen off the bed in his effort to escape and then had rolled under it, seeking protection. The flames followed him and his clothes were burned off. He had died of suffocation and burns.

Unprotected Stoves, Heaters and Grates — 11 Deaths.

LYNN, MASS., Dec. 4.—Miss Florence Bayrd, of Empire Street, Lynn, died at the Lynn Hospital today from burns received when her clothing caught fire from the kitchen stove.

BATH, ME., Dec. 11.—Nettie E. Hilton, aged 12, daughter of Mr. and Mrs. George B. Hilton of 76 Russell Street, died today from burns sustained at her home.

Her mother was out hanging clothes. When she returned she found the daughter in the kitchen, with her clothing burned off and her body horribly burned. She was hurried to the City Hospital, but died on the way.

The presumption is that the little girl went to the stove, that flames burst out and set fire to her dress.

BEVERLY, MASS., Dec. 11.—Miss Abbie A. Cressy of 30 Wallis Street was found lying on the floor of her home shortly before 4 this afternoon, burned to death.

Miss Cressy lived alone in the lower tenement of the dwelling. Miss Caroline Clemens, who lived in another section of the house, traced a smoke odor to Miss Cressy's apartment. She found the room in flames and Miss Cressy's clothing on fire. By the time the fire department arrived Miss Cressy had been so badly burned that she lived but a few minutes. The fire in the room was quickly extinguished.

It is the opinion of the firemen that Miss Cressy had been using the stove poker and that some hot coals dropped from the stove and fired the straw matting, which set her clothing afire.

SWAMPSCOTT, MASS., Dec. 18.—Carmela Musto (4), of 33 New Ocean Street, Swampscott, died early last night at the Lynn Hospital from burns received earlier in the day when her clothing caught fire while she and her brother Louis were playing with the furnace in the cellar of their home. The child was unconscious when brought to the hospital. Her clothes had been almost entirely burned off.

KINSTON, N. C., Jan. 17.—The badly burned little body of Rosebud French (4), who died from injuries received when her clothing caught fire from a stove at the residence of L. T. Moreadith here, was buried in Craven County yesterday.

STATESVILLE, N. C., Jan. 17.—Laura, the little five-year-old daughter of Mr. and Mrs. L. K. Houston, who live in Shiloh Township, about six miles from Statesville, was burned to death at her home Tuesday afternoon, it being supposed that her clothing caught fire while she was standing too near an open fire in the room where she was playing with several other small children. The mother of the little girl was in another room at work, when she heard screams in the room where the children were playing, and on going into the room found the little girl's clothing in flames. She quickly extinguished the blaze, her hands being badly burned in the attempt. A physician was hastily summoned and everything possible done for the little sufferer, but to no avail, and she died a few hours later.

A twelve-year-old daughter of Carrie Sharpe, colored, was probably fatally burned at her home here yesterday afternoon. The girl's clothing caught, also, standing too near an open fire. She is still alive, but doctors say she has no chance of recovery.

NEW HAVEN, CONN., Feb. 4.—Margaret Dorothy Clifford, six and one-half years old, daughter of Daniel Clifford, 284 Blatchley Avenue, died of burns at her home yesterday afternoon at 3 o'clock, another victim of the new style open front gas heaters.

About 10:30 in the evening the child was undressing before the gas heater at the home of a friend with whom she was staying when her clothing caught fire. The blaze was put out by a member of the family, who was in the room at the time, but the child was badly burned about the body. She was taken home, and physicians made all possible efforts to save her, but in vain.

The death of little Margaret brings to mind the similar fate suffered by Mrs. Barrett of Ferry Street about a month ago. These facts led Dr. Scarbrough to condemn the new heaters which have been introduced in this city as very dangerous ones. Those who have the new heaters installed in their homes should be very careful not to stand too near while the heater is lighted, or let curtains or other inflammable material get near the stove.

SAN FRANCISCO, CAL.—Margaret Morgan, 3 years old, of 810 Webster Street, died at San Francisco Hospital as the result of burns received when her dress caught fire as she reached to the mantel to get a toy.

TORONTO, ONT.—Little Reif Delillo, daughter of Tony Delillo, of 113 Elm Street, died in the Hospital for Sick Children from shock brought about by severe burns. While playing about a stove in her home, the child's clothes were ignited by a spark from the stove.

BOSTON, MASS.—Lawrence Ritchie, the 4-year-old son of Mrs. Bessie Ritchie of 54 Haynes Street, East Boston, died in hospital from burns.

The infant's nightdress took fire from the kitchen range. His mother was in another part of the house dressing. She heard the screams of the child and hastened to his aid. With a blanket she extinguished the blaze.

Poorly Installed or Overheated Furnaces, Stoves, Stovepipes, etc. — 28 Deaths.

SOUTH WINDHAM, ME., Nov. 28.—Two children were burned to death today in a fire that destroyed the home of Edward Jewett, their father. They were Cora, aged 12, and Vera, aged 10. Mr. Jewett was terribly burned on the head, arms and hands in repeated attempts to rescue them.

Six other occupants of the small frame structure, including three children, were saved from death by rushing through smoke and flames or dropping from upper windows. The fire was caused by an overheated stove.

CARIBOU, ME., Jan. 16.—The six children of Mr. and Mrs. Charles Bard, who reside on the Van Buren road in Connor, about eight miles from this town, were burned to death in a fire that destroyed their home early Tuesday morning.

Mrs. Bard is in a serious condition as the result of burns received while trying to rescue her children.

It is supposed that the fire caught from a defective stove pipe soon after Mr. Bard had built a hot fire and left the house for his work.

YONKERS, N. Y., Jan. 21.—Three children were burned to death in a fire which swept through the apartment house at No. 189 Oak Street this afternoon.

The fire, which is believed to have started in the cellar from an overheated furnace, crept quickly, and undiscovered, through the building, breaking into flame at the third floor.

The mother, unaware of the spread and headway of the fire, determined to carry her crippled husband to safety and then return for the younger children, who were sleeping in their nursery. Her thought was carried out with the aid of a nineteen-year-old son. Then mother and son turned back into the flames to bring out the little sleepers.

It was too late. In the brief time taken by the rescue the interior of the building had become a seething mass of flame and choking gases.

MARTINEZ, CAL., Jan. 31.—Three men were burned to death, five others injured and the lives of over sixty more jeopardized when the Fairview Hotel, a workingman's hotel and boarding house, was destroyed by fire early this morning. The blaze started from an oil stove in one of the rooms on the first floor. The flames burned away the two stairways leading to the rooms above, completely closing this means of escape to some forty lodgers located in the upper story.

PEABODY, MASS., Feb. 22.—Mr. and Mrs. Morris Miller and seven of their eight children were burned to death when fire destroyed their farmhouse on Lowell Street in West Peabody today.

The only surviving member of the family of ten is a nineteen-year-old son, who was not in the house.

The farmhouse was a one and one-half-story wooden structure. The parents and children slept in three upstairs chambers, which were heated by coal stoves. It is thought that the fire was caused by an overheated stove.

OWEN SOUND, ONT., June 11.—One of the worst tragedies in the history of Grey County has been reported here from one of the remote parts of the county. A farmhouse with all its occupants, five in number, was destroyed by fire at an early hour Saturday morning last. The home was that of Richard Lyons, Euphrasia Township, who lost his life, together with his wife and their only son, Lawrence, aged eight years. A farmerette, Miss Effie Neely, a student at the Markdale High School, lost her life, and also a four-year-old boy, Auldes McLaughlin, of Owen Sound.

The origin of the fire is a complete mystery, but it is thought that sparks from a stovepipe running through the roof of a rear shed, fairly close to the main

building, ignited the gable end of the house, which was of frame construction, and that the occupants were suffocated before they could make their escape. The fire was noticed by neighbors, but before they reached the scene the building was a mass of flames. The bodies of four of the victims were found together in a heap. Whether these four were huddled together in their own room when death came to them, or whether they had tried to reach safety and were caught at the bottom of the stairs, will never be known, but by the position of the bodies when found it would appear that they had gone down the stairs, where, as in many other houses, *there was a small landing at the bottom, with the door opening inward, and that, with one or two probably fallen, suffocated, the others were unable to open the door, and perished within a few inches of safety.*

Children and Infirm Persons Left by Themselves — 12 Deaths.

CALGARY, ALBERTA, Nov. 29.—While their parents were absent, attending a Chautauqua lecture, five children of Mr. and Mrs. Geo. Oakes were burned to death when the farmhouse, four miles south of Innisvail, was destroyed. The dead children ranged in age from 15 months to 13 years.

SOUTHBORO, MASS., Dec. 13.—Mrs. Lewis Brewer is believed to have lost her life in a fire which destroyed her house and stable here tonight. She has not been seen since the flames were discovered, and as she was 85 years old and lame, it is feared she was unable to escape. At the time the fire broke out she was alone in the house.

ADAMS, MASS., Dec. 17.—The three-months-old infant son of Nelson Garno was fatally burned and another baby, aged two years, was rescued, when fire destroyed the Garno home here late today.

E. Perreault entered the burning house before the arrival of the fire department and brought out the two children, receiving painful injuries.

SAN FRANCISCO, CAL., Jan. 27.—High up on a hill near Visitacion valley yesterday Gina Pera, 3 years old, and Bruno Pera, 6, frantically beat their tiny fists upon the locked door of their home while spreading flames enveloped the little house. Before aid could reach them they were burned to death.

The mother of the children was four blocks away visiting a neighbor. The father was at work. The mother had left the children playing about the house.

From the window of the neighbor's home Mrs. Pera saw her house in flames. She called to her friend and the two screaming women ran down the unpaved street, stumbling over stones, until they reached the burning house. There Mrs. Pera fainted.

Firemen found her on the doorstep. The screams of the children had ceased and the house was a raging furnace.

When firemen broke down the door they found the tiny bodies lying side by side on the floor.

The cause of the blaze could not be determined. The children, it is believed, were either playing with matches or their clothes caught fire from the stove, in which their mother had started a fire when she left home.

MILLBURY, MASS., Feb. 18.—Hazel, aged 4, and Arthur, aged 2, children of Mr. and Mrs. Harry Longwell, were burned to death at noon in the Longwell bungalow at Dority Pond today. The mother had locked the little ones in the house while she went on an errand to a neighbor. The origin of the fire will remain a mystery, as the house was destroyed.

BOWMANSTOWN, PA., March 17.—Emanuel Bateman, a Civil War soldier, living alone in a small house near here, was burned to death by the overturning of an oil stove. The house was destroyed.

The case of a South Boston boy, aged 7 years, who was locked in a room while his mother was shopping, and set fire to his clothing by lighting papers at the gas stove, should probably be added to the

above. The injuries sustained by the child left little hope for his recovery.

Starting Fires with Kerosene, etc. — 4 Deaths.

LYNN, MASS., Nov. 12.—With her clothing in flames, Miss Harriette L. Balch, of 5 Russell row, ran out of the house this afternoon and, fifty feet away, she dropped dead. Neighbors who heard her screams poured water upon her and extinguished the flames.

She was starting a fire in the kitchen range and apparently used kerosene.

COLFAX, WASH., Nov. 22.—Mrs. Eunice Stone, aged 79, was terribly burned at her home in Colfax while starting a fire with coal oil. She was alone at the time and neighbors rushed to her aid, finding her clothing entirely burned. She was hurried to the hospital, but died during the night.

ASBURY PARK, N. J.—From burns suffered in her home when her clothing took fire while she was pouring kerosene into the furnace, Miss Lida A. Doren, Superintendent of Schools for Neptune Township, died today in the Asbury Park Hospital. She was 60 years old and was widely known among New Jersey educators.

(*Location Unstated.*)—An engineer at the power house of a large institution fell asleep and allowed his fire to go out. Upon awaking, he secured some waste, saturated it with kerosene and lighted the fire.

Although he had had twenty-five years' experience as a fireman and engineer, he thoughtlessly failed to open the damper when he rekindled the fire. When the door was suddenly opened, the flames shot outward and ignited his clothing, inflicting burns that caused his death three days later.

Eleven other cases of severe burning—five of them probably fatal—have been reported as the result of similar conduct to that for which the four persons mentioned above paid with their lives.

Oil Lamps — 3 Deaths.

NEEDHAM, MASS., Dec. 10.—Mrs. Sarah T. Freeman, wife of James Freeman, was burned to death at her home, 41 Mellen Street, Needham Heights, this afternoon.

A neighbor noticed smoke coming from the Freeman house about 4:45, but was unable to enter the house on account of the flames. She summoned employees of a nearby garage, and they, after sounding an alarm, found Mrs. Freeman on the kitchen floor. She was dead, with a kerosene lamp by her side. Mrs. Freeman was alone in the house at the time. She was subject to fainting spells, and is believed to have fallen with the lamp in her hand.

CONCORD, N. H., Dec. 17.—Mrs. Hattie M. Wyatt, Concord's oldest milliner, was found dead from burns at her home, 49 Laurel Street, this morning. Neighbors saw a blaze in her kitchen and telephoned the Central Fire Station. Upon the arrival of the firemen they found a couch bed in the kitchen on fire, evidently from an overturned lamp, and near the couch the badly burned body of Mrs. Wyatt.

PROVIDENCE, R. I., Jan. 30.—Sadie Costa (4), a daughter of Mr. and Mrs. Marian Costa of River Street, Riverpoint, was fatally burned shortly after 10:30 yesterday morning.

The girl had been left alone in the house, when her mother went out to the store. It is believed that she made her way upstairs and that, while lighting a lamp, her dress caught fire from the wick. She ran downstairs and fell on the kitchen floor. Almost immediately afterward a young girl, who happened to step in, called a neighbor.

When the latter reached the house all of the child's clothing had been burned off, excepting the shoes.

Bonfires — 3 Deaths.

WOONSOCKET, R. I., Nov. 15.—Burns received by Rosanna Jalette, the 3-year-old daughter of Mr. and Mrs. George Jalette of 469 Grove Street, Woonsocket, Tuesday morning, when her clothing became ignited while she was standing near a small fire started by a playmate in a field near her home, proved fatal. She died yesterday morning at 5:30 at the Woonsocket Hospital.

PROVIDENCE, R. I., March 21.—Fransica Nasise, the 5-year-old daughter of Mr. and Mrs. Joseph Nasise of Elm Street, Norton, received burns Monday afternoon, while playing in the yard of her home, from which she died at 3 o'clock yesterday morning in the Sturdy Memorial Hospital, Attleboro.

The little girl was playing with some other children in the yard of her home, when someone lighted a fire. The blaze ignited the clothing of the Nasise girl, and she started to run. As she ran the wind gave force to the blaze, and, instead of running toward the house, she ran in the opposite direction. Her screams attracted the attention of her parents, and the child was finally caught and the fire put out.

DORCHESTER, MASS., April 28.—John Costello (8), of 36 Woodrow Avenue, Dorchester, was fatally burned yesterday afternoon when his clothing caught fire from a bonfire on Pleasantview Street. He died at the City Hospital late last night. He was the son of Mr. and Mrs. John Costello. With playmates, he was watching the fire when an ember snapped into his clothing. Before it could be dislodged his clothing was in flames, which enveloped him.

On March 16, twenty persons were burned to death at a fire in a lumber camp at Alvin Siding, N. S. The dead included the wife and six children of one of the lumbermen. The fire started in a dormitory while the occupants were asleep, and the building was a mass of flames before they could escape.

On May 29, fire destroyed a ward of the Hospital for the Insane at Columbia, S. C., killing ten patients and seriously injuring many others. The cause of the fire was probably defective electric wiring.

Unknown causes were responsible for fires at Greenwood, S. C., on December 24, in which a mother and 6 children lost their lives; at Sargent, Neb., on January 18, destroying a mother and 2 children; at Conifer, N. Y., on February 7, involving both parents and 3 children; and at Glens Falls, N. Y., on April 8, when an old farmer perished.

In San Francisco on January 8th one death immediately followed a candle-light search for a gas leak, a second person being very dangerously injured. A similar search a few weeks earlier in Somerville, Mass., had resulted in a name on the danger list at the local hospital.

The folly of going back into a burning building is illustrated by a fire at Healdsburg, Cal., on February 20, when a man lost his life by re-entering his home at his wife's request in search of baby clothes. An illustration on a larger scale was reported on April 26 from Brookline, Mass., where five employees after reaching the street returned to a burning bakery in an effort to secure their personal effects. All five were trapped by the flames.

Explosion of a gas pipe in the basement of the Dempsey Hotel, Macon, Ga., was responsible for two deaths, as was an explosion, either of oil or gas, in the cellar of a three-story apartment house at Trenton, N. J. At Wyndemere, N. D., on April 12, an exploding gasoline tank caused a fire at a farm home in which a mother and three children were burned.

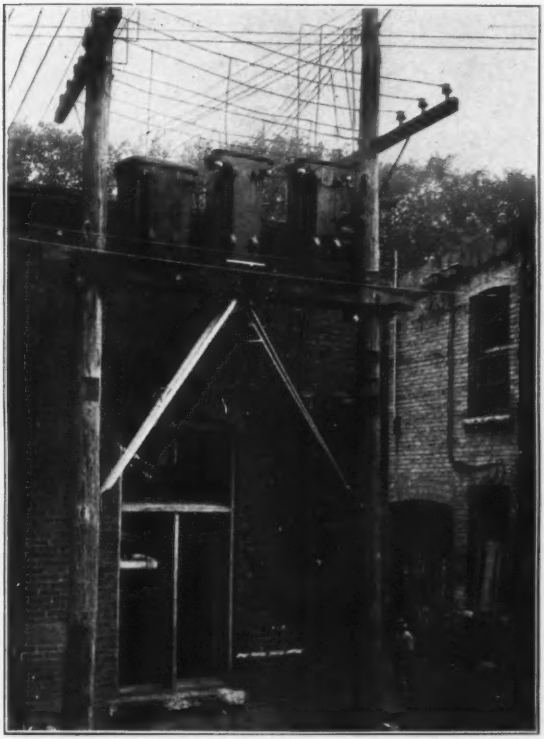
Three persons lost their lives while trying to escape by the stairs of a theatrical rooming house in New York City on March 29, and one woman fell to her death while attempting to escape through a window. A press clipping is also to hand on the subject of a lodging house fire in San Francisco in November last. Only one life was lost, but the work of rescue was rendered extremely difficult by the condition of the streets leading to the house, these passing through a number of lumber yards. In another lodging house fire, which occurred at Rockland, Mass., on May 10, one of the lodgers was partly overcome by smoke and rolled under a couch, his charred body being discovered after the fire. Two other men were taken to hospital suffering from burns.

An employee of the Boston Café at Peterboro, Ont., fell a victim when the emptying of a pail of grease into the kitchen range led to a fire which swept rapidly up into the second and third stories of the building, cutting off the cooks and their helpers, who were sleeping in the third story, from the stairs. Other employees were rescued from the windows by firemen.

Unusual deaths by fire were those of four Japanese workmen in the Southern Pacific yards at Los Angeles, who awoke on the morning of January 24 to find themselves locked in a section gang car enveloped in flames; of Herbert Smith, Jr., who died at Lenox, Mass., on March 27, in a heroic effort to save horses and cattle from a burning barn; and of three men of the 113th aero squadron, U. S. A., who were burned to death when the guard house to which they were confined for minor offences took fire on December 16 last.

The rapidity with which the magnificent home of William Jay Barker in Thrushwood Park, Riverside, Conn., burned on February 6—involving the death of its owner and grave peril to many others—is but the latest proof of the inadequacy of the attention generally given to the matter of fire-stopping in residences upon the architectural beauty and other features of which no expense is spared.

The foregoing record is very far indeed from being complete. It is based on clippings made in the Association's Executive Office, supplemented by contributions from members H. Belknap of Cambridge, Mass., C. Heller of San Francisco, and M. E. H. Sailman of Toronto. That so fragmentary an account, from which the hazards of industry are designedly excluded, should show a toll of more than 200 lives within a period of six months is a matter that might well be taken up by those who are already active on other lines in the campaign for the conservation of the nation's child life.



Transformer Bank which was wrecked when one unit syphoned its oil down secondary leads.

Oil Leakage Causes Transformer Failure.

By Francis Miller.

Courtesy of Electrical Review.

The importance of having distributing transformers—all oil-immersed apparatus so far as that goes—properly filled with oil and with oil maintained at all times in proper condition might appear so obvious as to be hardly worth mentioning. However, in one case failure to appreciate this fact resulted in far-reaching consequences in a way that deserves mentioning. The following experience serves to emphasize the importance of attending to one factor of installation and maintenance that often receives far less consideration than it should.

The installation in question consisted of three transformers resting upon a platform, which in turn was mounted upon two poles, as seen in the accompanying photograph. These transformers served the adjacent factory and at high load factor since the factory was working two shifts of nine hours each. Moreover, the transformers during the active working period carried about 10 per cent overload. The heating of the units will be understood to be higher than is usually the case for transformers used for distribution, hence it was more important than ever that the oil be in good condition and up to full level.

In the present instance one transformer was destroyed and damage, if not destruction, narrowly averted to the remaining two. After the plant had shut down, the transformer on the left-hand side caught fire. In some way the fire spread and set the cross-arms supporting the transformers on fire. When this had burned sufficiently to weaken the strength of the platform, the transformer fell to the ground. Part of the left-hand pole was also burned, necessitating removal of the remaining two transformers and erection of a new platform.

The incident, apart from being serious and expensive, was peculiar. The apparent cause of the fire was an arc that had started in the transformer above the oil level, which was presumably low. The secondary leads had syphoned oil which had lowered the oil level and permitted the oil to trickle down the platform floor. It is presumed the fire had in some way followed down the oil-soaked leads to the wooden platform, since the leads were burned bare of insulation. It was fortunate that the galvanized iron braces had been installed, as otherwise all three transformers would have been lost.

The incident emphasizes the importance, on the score of fire hazard as well as reduction of transformer capacity, of preventing oil from syphoning, whilst reduced oil level makes a winding more susceptible to attack from lightning.

Comparative Statistics of Fire Loss.

In its Annual Report for 1917, which is somewhat briefer than usual, the Committee on Statistics and Origin of Fires of the National Board of Fire Underwriters calls attention to the opportunity presented by existing conditions for public education in fire prevention. It recognizes the good work accomplished during the year by progressive fire chiefs in some cities, but urges that much more be undertaken along these lines in the future. Although the fire waste of 1917—$250,753,640, or $2.42 per capita—was greater than that of any year since 1875, with the exception of 1906, the year of the San Francisco conflagration, the Committee is of the opinion that but for the devotion shown by the various public officials, associations and fire departments, it would have been much larger.

The following tables are taken from the Committee's report:

State Fire Marshals.

STATE	No. of Employees		No. of Towns or Cities Visited	No. of Inspections Made			No. of Orders issued for correction defects	No. of Bldgs. Condemned or Razed	No. of Arrests for Incendiarism	No. of Convictions secured	No. of Deaths as the result of Fire	No. of Persons Injured	No. of Circulars or Pamphlets Issued	No. of Fire Prevention Addresses made
	Office	Field		General	Schools	Theatre								
Alabama														
Arkansas														
Connecticut														
District of Columbia		6	1				600		4		13	103	13	100
Georgia														
Illinois														
Indiana	7	5	89	13,676	9	293	13,978	803		13			21	19
Iowa	1	3	910	2,494			409	176	16	11	42		10,000	36
Kansas	4	4	132	1,908	103		250		31	12			30	35
Kentucky	2	8					6,678	500	68	19				
Louisiana	3	8	185	4,514	471	59	1,906	24	25	4	46	33	62	14
Maine														
Massachusetts														
Michigan	3	5		613		1,374	1,030	154	39	20	143	192	*36	
Minnesota	5	5	114	4,068	107	1,006	3,184	241	26	7			10,000	
Mississippi														
Montana	1		80	42	35	24	46	*161	8				6	
Nebraska	2	5	500	8,000	200	100	460	20	11	3	57	100	24	8
North Carolina	3	8	161	1,240	1,010	124		24	47	17	317		750,000	950
North Dakota	1	2		1,145	32	12	105	22	3	3				15
*Ohio	16	33	634	15,085	500	641	14,754	4,436	114	101			71	30
Oklahoma														
Oregon	1	3	38	2,265	63	25	868	38	1	*	2	6	34	32
Pennsylvania	3	14		7,079	34	83	1,315	284	95	40	107		352,000	100
South Carolina														
South Dakota	1	2	409	284	112	354	600	75	5	1	30		12	100
Tennessee	6						150	12	20	14			73	5
Texas	41		413	40,430	244	608	7,504		13	15			15	6
Vermont														
Virginia														
Washington														
West Virginia														
Wisconsin														
*Also did considerable conservation work not included in records.								*104 Removed		* 2 Confessions			*Also special proclamations	

Cities in Which Loss Exceeded $5.00 Per Capita.

1917.

Hazelton, Pa.	$14.37	Omaha, Neb.	$ 6.81
Kansas City, Kan.	11.13	*Charlotte, N. C.	6.74
Lexington, Ky.	11.04	Springfield, O.	6.45
*Lynchburg, Va.	10.42	‡Dubuque, Ia.	6.31
*Albany, N. Y.	9.99	‡Fresno, Cal.	6.09
Wheeling, W. Va.	9.58	*Augusta, Ga.	5.92
Des Moines, Ia.	9.57	Nashua, N. H.	5.91
*Erie, Pa.	9.31	*Chicopee, Mass.	5.88
Saginaw, Mich.	9.02	Council Bluffs, Ia.	5.85
Stamford, Conn.	7.95	El Paso, Tex.	5.57
‡East St. Louis, Ill.	7.91	Paducah, Ky.	5.44
Hartford, Conn.	7.50	*Boston, Mass.	5.27
Dallas, Tex.	7.30	*Houston, Tex.	5.14
Bangor, Me.	7.28	*New Rochelle, N. Y.	5.01
*Norfolk, Va.	6.86		

1916.

Jersey City, N. J.	$27.71	*Houston, Texas	$ 6.90
Asheville, N. C.	14.93	‡East St. Louis, Ill.	6.28
†Ottumwa, Ia.	12.68	*Little Rock, Ark.	6.27
Green Bay, Wis.	12.08	*Chicopee, Mass.	5.97
‡Dubuque, Ia.	9.12	Cedar Rapids, Ia.	5.94
Fall River, Mass.	9.09	*Portland, Me.	5.87
Shamokin, Pa.	9.07	Amsterdam, N. Y.	5.81
*Peoria, Ill.	8.51	Duluth, Minn.	5.75
*Norfolk, Va.	8.25	New Castle, Pa.	5.09
†Columbia, S. C.	8.10	Spartanburg, S. C.	5.07
Sandusky, Ohio	7.60	*Cohoes, N. Y.	5.05
Austin, Texas	7.43		

1915.

Newport News, Va.	$28.00	Danville, Ill.	$ 6.86
Clinton, Ia.	12.46	Joliet, Ill.	6.83
*Augusta, Ga.	11.87	*Galveston, Tex.	6.52
Raleigh, N. C.	10.37	Springfield, Ill.	6.47
Key West, Fla.	9.41	‡Fresno, Cal.	6.24
Lockport, N. Y.	9.31	†Port Huron, Mich.	6.06
Muncie, Ind.	9.16	†Salem, Mass.	5.85
Davenport, Ia.	8.80	Muskegon, Mich.	5.57
*Trenton, N. J.	8.11	Williamsport, Pa.	5.48
*Erie, Pa.	7.78	‡Dubuque, Ia.	5.35
‡Shreveport, La.	7.64	Burlington, Ia.	5.14
Wilkinsburg, Pa.	7.50	Oswego, N. Y.	5.14
*Montgomery, Ala.	6.94		

1914.

*Galveston, Tex.	$33.06	Portland, Ore.	$ 6.78
Pottsville, Pa.	20.38	Kearny, N. J.	6.48
†Port Huron, Mich.	16.13	Kenosha, Wis.	6.47
*Trenton, N. J.	15.32	*Portland, Me.	6.26
Decatur, Ill.	15.28	*Binghamton, N. Y.	6 24
Manchester, N. H.	14.07	Waco, Tex.	6.12
Superior, Wis.	13.86	‡East St. Louis, Ill.	6.10
Charleston, W. Va.	13.83	‡Shreveport, La.	6.05
*Waterloo, Ia.	12.60	Pasadena, Cal.	5.97
*Gloversville, N. Y.	12.29	*Pittsfield, Mass.	5.93

1914.

‡Fresno, Cal.	$12.03	Portsmouth, Ohio	$5.93
*Montgomery, Ala.	10.51	Memphis, Tenn.	5.67
*Sioux City, Ia.	10.43	*Albany, N. Y.	5.46
Vicksburg, Miss.	9.38	Montclair, N. J.	5.12
Leavenworth, Kan.	9.12	Forth Worth, Tex.	5.05
†Birmingham, Ala.	7.37	Mobile, Ala.	5.04
*Charlotte, N. C.	7.28		

1913.

*Columbus, Ga.	$40.91	Elmira, N. Y.	$ 8.49
†Ottumwa, Ia.	16.39	Jackson, Miss.	7.58
*Cohoes, N. Y.	15.43	Parkersburg, W. Va.	7.50
Savannah, Ga.	13.91	Norwood, Ohio	7.30
†Port Huron, Mich.	13.72	Walla Walla, Wash.	6.99
Quincy, Ill.	13.26	†Columbia, S. C.	6.50
*Salem, Mass.	12.08	*Binghamton, N. Y.	6.45
*Gloversville, N. Y.	11.81	Springfield, Mo.	6.42
Dayton, Ohio	11.60	*Little Rock, Ark.	6.31
‡Dubuque, Ia.	10.43	*Peoria, Ill.	5.83
‡East St. Louis, Ill.	10.12	*Boston, Mass.	5.79
*Lynchburg, Va.	9.94	‡Fresno, Cal.	5.52
Everett, Wash.	9.69	Burlington, Vt.	5.39
San Jose, Cal.	9.39	Stockton, Cal.	5.33
‡Shreveport, La.	9.17	Flint, Mich.	5.01
*New Rochelle, N. Y.	8.69		

*These cities in this class in two of the five years.
†In this class three of the five years.
‡In this class four of the five years.

*Annual Fire Losses in the United States for Forty-three Years—1875-1917 Inclusive.

YEAR.	AGGREGATE PROPERTY LOSS.	YEAR.	AGGREGATE PROPERTY LOSS.	YEAR.	AGGREGATE PROPERTY LOSS.
1875	$78,102,285	1890	$108,993,792	1904	$229,198,050
1876	64,630,600	1891	143,764,967	1905	165,221,650
1877	68,265,800	1892	151,516,098	1906	215,084,709
1878	64,315,900	1893	167,544,370	1907	215,084,709
1879	77,703,700	1894	140,006,484	1908	217,885,850
1880	74,643,400	1895	142,110,233	1909	188,705,150
1881	81,280,900	1896	118,737,420	1910	214,003,300
1882	84,505,024	1897	116,354,575	1911	217,004,575
1883	100,149,228	1898	130,593,905	1912	206,438,900
1884	110,008,611	1899	153,597,830	1913	203,763,550
1885	102,818,796	1900	160,929,805	1914	221,439,350
1886	104,924,750	1901	165,817,810	1915	172,033,200
1887	120,283,055	1902	161,078,040	1916	214,530,995
1888	110,885,665	1903	145,302,155	1917	250,753,640
1889	123,046,833				

*These figures are obtained from the Records of the Journal of Commerce, deducting the Canadian losses.

Tobacco Waste and Fire Hazard.

By Henry W. Farnam,

Professor of Economics at Yale University.

(Member N. F. P. A.)

Reprinted from The Investment Weekly, for March 23, 1918.

When the Chief Justice of the King's Bench said to Falstaff: "Your means are very slender and your waste great," the fat knight ruefully replied: "I would my means were greater and my waist slenderer." Now that our country is feeling the pinch of war, many are beginning to think, with Falstaff, that our waste has been too great, and that a good deal of our apparent wealth is no more a sign of national efficiency than Falstaff's big waist was a sign of physical vigor. Few, however, realize that our national waste is often disguised as a money-making investment.

As an example, but by no means an isolated one, let us take the tobacco industry. The amount spent on tobacco by our people in the fiscal year ending June 30, 1917, was probably not less than $1,200,000,000. These figures mean little to the general reader, for all statistics are big when applied to a nation of 100,000,000 people. We can only realize their significance by comparing them with the figures for other staple products. Here are a few samples:

Value of all metals mined in the United States in 1915 (iron, copper, gold, silver, etc.)....		$992,816,853
Bituminous coal mined in 1915.....	$502,037,688	
Anthracite coal mined in 1915.....	184,653,498	
		686,691,186
Cost of building operations in 51 largest cities of the United States in 1916.....		780,183,970
Total cost of education, including common schools, universities, etc., in 1916.....		914,804,171
Expenditure on highways in 1916.....		290,000,000
Total receipts from passenger service on railroads, including parlor cars, in 1916.....		652,027,450

These figures are sufficient to put tobacco in its proper perspective. They show that our tobacco bill is not only enormous in itself, but that it is very large compared with other bills, and the practical question is: What does the country get for its money? The answer is, the non-smoking majority get nothing. The smoking minority get what physicians call *euphoria*, a certain narcotic gratification which need not be further defined. a mere sensation, only that and nothing more. Whether or not it is in itself a good thing need not be discussed. The question is whether we as a country are or are not paying too high a price for supplying this particular want.

Let us make a further comparison. In England the smoking habit is very common, and in many circles more common than with us, since smoking is more the fashion among women. Yet Great Britain consumes (or did the year before the war) 2.09 pounds per capita to our 5.57. If we were to content ourselves with the amount which the English consider sufficient, we should cut down our tobacco bill by over 60 per cent, or, let us say, $720,000,000. That means that if we had decided, not to swear off, but merely to save the excess and put it into permanent structures, we could have duplicated nearly all of the new buildings that were constructed in our fifty-one leading cities two years ago. If we had chosen to put it into metals, we could have added 70 per cent and more to our output. If we had elected to put it into coal, we could have more than doubled our total output of anthracite and bituminous coal in 1915. We could have added about 80 per cent to our expenditure on education. We could have multiplied by three our expenditure on good roads. I have taken tobacco as a type, but there are other things which are in the same class. Alcoholic drinks cost us last year about $1,600,000,000, or about a third more than tobacco. If we could have cut down our liquor bill by 60 per cent we could have invested the savings in the products mentioned above with an addition of 33 per cent.

Now, all of the money spent on such things affects other investments in two ways. (1) It competes with other investments in the demand for capital. The capital that is put into liquor or tobacco cannot at the same time be invested in mining or railroading or agriculture or buildings. (2) Tobacco directly interferes with investments in general, partly by the large number of fires which it causes, partly by the effect of excessive smoking, particularly in the form of cigarettes, on the efficiency of the worker. The former is more tangible than the latter, and Mr. Johnson, late Fire Commissioner of New York, estimated that from 15 per cent to 20 per cent of all fires in the United States were due to smokers.

The loss in efficiency is not so definite, but when such successful men of business as Henry Ford and Thomas A. Edison express themselves strongly against it, when such employers of labor as the Cadillac Motor Car Company, the Larkin Company of Buffalo, the Burrows Adding Machine Company of Detroit, Marshall Field & Company of Chicago, John Wanamaker of Philadelphia, and many others condemn the use of cigarettes by their employees, the evil of excessive cigarette smoking cannot be a matter of indifference. Yet it is precisely in this form that the most amazing increase has taken place in recent years, the cigarette production having grown from 5,000,000,000 in the calendar year 1907 to 30,000,000,000 in the last fiscal year.

If but a small part of the money which the country has spent on *euphoria* during the past ten years had been put into things of greater permanence, and if but a small part of the capital devoted to the production and sale of tobacco and alcohol during that period had been put into irrigation projects or good roads or dwelling houses or railroads, we should now have more food, better housing accommodations for the working classes, better equipped railroads. In short, those basic in-

dustries which are so essential for all business enterprises would be in a better position to stand the strain of the extraordinary demands of war. If but a small part of the money spent on tobacco during the last ten years had been put into schools in those parts of the country where education is most backward, we should not now face the humiliation of having 5,500,000 illiterates in the country, and being obliged to draft into our army soldiers who cannot read the army regulations. No wonder that President Wilson says: "I suppose we have several times over wasted more than we are now about to spend. We have not known that there was any limit to our resources; we are now finding out that there may be if we are not careful."

If a banker were called upon to help finance a factory established for the production of burglars' tools, he would at once realize that by so doing he would be helping to destroy the very security which is the cornerstone of banking. The incongruity is not so marked, and therefore not so commonly seen when a business militates against other forms of investment, not intentionally, but through its excesses. A fact unrealized is a fact nevertheless, and the investor who has a limited amount to invest must establish a certain rule of priority and decide whether or not one kind of investment is going to help or hinder investments as a whole under conditions as they now exist. Mr. Vanderlip has well said: "If a dollar is spent for any luxury, for any unnecessary thing, that dollar has been put into competition with the Government's dollar." It is equally true that a dollar invested in the production of an unnecessary thing is put into competition with investments in things which are necessary and fundamental.

Editorial Comment.

By Franklin Escher, Vice President of *The Investment Weekly.*

"Don't run this article of Professor Farnam's," said a member of our staff whose opinion we highly respect, "and for goodness sake throw away this editorial about the tobacco stocks. Don't you realize that all that it will do is to antagonize some of the strongest people in the country, and make a bad feeling among a number of our readers? People want to smoke, and smoke all they feel like, and nothing that can be said on the subject is going to change them in the slightest or cause anything but a feeling of irritation at being preached at."

At a time when a wave of thrift is sweeping the country from one end to the other, when men of wealth are almost ashamed to be seen riding around in new-bought automobiles, when last year's clothes are being made to do for another season, we are spending $1,200,000,000 annually for an out-and-out luxury, tobacco.

In 1907 there were consumed in this country five billion cigarettes. Last year there were consumed thirty billion.

We are not of that narrow class of people who would like to see the use of tobacco done away with entirely, but, with the situation as it is, it is becoming increasingly plain that the consumption of tobacco is on an unreasonably large scale. There are more people in the country today than there were ten years ago, it it true, and we are richer, too,

and better able to spend money. That measure of increase, however, is by no means in line with the six-fold increase, for instance, in the consumption of cigarettes. Aside from any question as to whether smoking is a good thing or a bad thing and as to whether or not it does any harm, it is apparent, from the figures given, that the use of tobacco has gone forward in recent years beyond all reason.

In England, as Professor Farnam points out, where the smoking habit is very common and where women smoke a good deal more than they do here, the consumption of tobacco in the year before the war was at at the rate of 2.09 pounds per capita as against 5.57 pounds in this country. We do things here in a big way, it is true, even little things, but in this fact that our consumption of tobacco is nearly three times as great as it is abroad, it certainly must be admitted that there exists food for a good deal of serious thought. Compare the consumption of tobacco in this country today with our own consumption of ten years ago, or compare it with the consumption of tobacco in other countries, and only the same conclusion can be reached—that the use of tobacco has been stimulated beyond all reason.

We smoke too much, you, I, and the next man. *We* are willing to admit it and we think you are, too. And this at a time when, of all times, thrift and moderation in the consumption of luxuries is of paramount importance to the attainment of the great national object!

Within the course of the next six months, we venture the prediction, a wave of sentiment against the present excessive use of tobacco, comparable to that which has resulted in so greatly reducing the consumption of liquor, will sweep the country. Tobacco has its place, and, except on the part of the most radical, there will be no demand that the use of tobacco be discontinued altogether. But on the part of the great mass of thinking people there is bound to develop a feeling that the use of tobacco is being vastly overdone and that it ought to be cut down.

The same thing has happened in all the other countries which are in the war. It is bound to happen here. People go on for a while living as they did before, but gradually, as the burden begins to bear down on them, they come to realize that "economy" is no hollow catchphrase, but something which must be practically put into effect. Long ago there was forced upon the country the necessity for economy in the use of foodstuffs. It would be strange indeed if, to the thinking American people, there were not brought home before long the realization that, in the consumption of twelve dollars' worth of tobacco by every man, woman and child in the country, there exists a situation into which some measure of economy might well be introduced.

The press of the country, with its tremendous amount of tobacco advertising, has naturally enough been anything but quick to take up the matter. It is a matter, however, which, press or no press, is beginning to force itself upon the attention of the people and which will continue so to force itself on their attention from now on with increasing insistence. We Americans are a logical people. Even though the papers hesitate about telling us so, it is bound to occur to a good many of us, when we hear from all sides about the necessity of "economy," that the

present excessive consumption of tobacco would be a good place to make a start.

Were we to reduce our tobacco consumption only to the level prevailing in other great tobacco-using countries prior to the war, we would save as a nation upwards of three-quarters of a billion dollars, and release, for war purposes, a tremendous manufacturing capacity and tens of thousands of skilled workers.

Postscript.

By Henry W. Farnam.

Three days after this article was published, "Windows all over Manhattan were rattled . . . by a series of explosions resulting from the burning of a five-story warehouse of the Jarvis Warehouse Company, Incorporated, which occupied nearly four blocks in Jersey City."* "The explosion deluged the Erie Railroad yards and machine shops, which adjoined them, with burning brands, starting fires that destroyed two of the Erie shops, damaged or destroyed twenty locomotives and a large number of freight cars loaded with merchandise. Burning fragments, blown across the Hudson River, started small fires on the water front on the New York side. Over an area of about half a mile in diameter about the plant in Jersey City the streets were filled with broken window glass. The shock of the explosion was felt in office buildings in lower Manhattan, and windows were broken as if heavy artillery were being fired in the streets below." "A second explosion rattled windows again and swept the vast column of smoke over lower Manhattan and New York harbor. Several smaller explosions followed." This account is taken from the *New York Times* of March 27th. The headline says: "Mayor calls it work of German agents." The afternoon newspapers, however, showed that the author of the fire was not a German agent, but simply one of our own, home-made cigarette smokers. The *New York Times* of Thursday, March 28th, tells the story as follows: "Davis and Altman had both worked among chemicals before and believed they were thoroughly acquainted with the nature of chlorate of potash. Both lighted cigarettes, according to Altman. Davis, Altman said, criticised one of the laborers when he asked if it were not dangerous to smoke where there were chemicals.

"Altman said they both continued smoking, and told the other men, who pretended to have no knowledge of chemistry, what substances would explode and what would not. One of the workmen said:

" 'Well, all right, if it is not dangerous. But I would not work in explosives for $10 a day.'

"According to Altman, Davis, in talking about chlorate of potash, said:

" 'This stuff won't even burn by itself. They use it in making black powder, and it is a fact that there is no kick in it by itself. If I mixed it with dirt it would burn, but it would not explode.'

"Davis said that Altman then threw away what remained of the lighted cigarette. It fell on a plank which was covered with dust from

* Further details regarding this disaster will be found on page 96.

the chlorate of potash. Altman said he took the precaution to put his foot on it, but threads of flames came out from under his shoe. He stamped several times, but apparently only fanned the blaze, which spread over the floor in a rapidly expanding circle. The dust burned like loose black powder grains."

The *Evening Post* in commenting editorially upon this event said: "As for the reckless employee, it may as well be recognized that there is a considerable number of men who will not pay attention to rules against smoking even in powder factories unless they are compelled to do so. Is there any reason why we should go on allowing ourselves to be possible victims of their criminal obstinacy?" But why should this employee be more blamed than thousands of cigarette smokers all over the country who are throwing down their cigarettes with even less regard to consequences and who are saved from public censure merely because their cigarettes happen to fall on non-inflammable matter?

The real cause of this and similar fires is the habit itself, and the blame is shared by all who promote the habit, either by example or by urging others to engage in it. The Jersey City fire is a good case of the wasteful investing described in the article reprinted above. The company which sold the cigarette doubtless made a profit on it, and is doubtless spending large sums of money every day on advertising in order to increase its sales. As against the profit of the tobacco company, there is a loss to the community of $2,000,000 in property. A good part of this loss probably fell on insurance companies, but as insurance losses are ultimately borne by the insured, all property owners have to pay in order that the cigarette company may make money. But this does not exhaust the list of the sufferers. Two of the Erie Railroad shops were destroyed. This means that all of the work carried on in them must be suspended until they can be reconstructed; meanwhile the workers must seek work elsewhere. Twenty locomotives and a large number of freight cars were damaged or destroyed. Just at present there is a serious shortage of rolling stock on all of our railroads, and the loss of twenty locomotives and a lot of freight cars will be felt by shippers of goods and by consumers. There are fewer locomotives to haul coal, food and other necessities. Some of the freight cars were loaded with merchandise, which means, even if the merchandise was covered by insurance, delay and loss to the consignees and their customers. The streets, we are told, were filled with broken window glass for an area of a half-mile in diameter, and even in the office buildings of lower Manhattan windows were shaken. All of the owners of these buildings were put to expense to repair the glass, and the tenants were seriously inconvenienced.

This is not an exceptional occurrence. Fires are being set by smokers all over the country every day, and this was on the whole relatively harmless in that no lives were lost. In the Triangle Shirt Waist fire, which was started by a cigarette smoker in 1910, over 140 innocent girls were killed. The report of the fire department of the City of New York for 1916 records 1606 fires caused by cigars, cigarettes, pipes, etc., and 1475 caused by the careless use of matches. As these figures do not include fires caused by children playing with matches, it is a fair as-

sumption that the great mass of match fires were caused by smokers. These two items together amount to 22.4 per cent of all the fires in Greater New York, and they involved a property loss of $875,000. The New York Fire Department is called out over three thousand times a year by the carelessness of smokers. Wherever the reports of fire marshals give the causes of fires, smoking figures as one of the most prominent. The last report of the Fire Marshal of Connecticut gave 96 fires as caused by cigars, cigarettes and pipes, and 167 as caused by matches, most of which were presumably used by smokers. These two items together amounted to about 16 per cent of all of the fires for which definite causes were assigned. Much has been said of late of the losses due to incendiarism on the part of German agents and others, but in the Connecticut report already quoted only 55 fires were suspected to be of incendiary origin. Of these the majority were on investigation otherwise explained, and only nine were thought to warrant legal action. Last month the newspapers published a report of the Actuarial Bureau of the National Board of Fire Underwriters, which made an analysis of 75 fires occurring since this country entered the war. The report says that "only four of the fires were incendiary." It is evident that the cigarette smoker is far more efficient as an agent of destruction than the German spy.

These facts are so serious than forty-eight large business corporations and enterprises (among them the New York Central Railroad Company, the Bush Terminal Company, and the Standard Oil Company of New Jersey) have put full-page advertisements in the newspapers calling attention to the damage done by smokers' fires. One of them refers specifically to the Jersey City fire as an object lesson. But as the same paper which prints the warning also prints the advertisements of the cigarette makers, the destruction goes on, our preparations for the war are hampered, and our enemies rejoice.

Standardization of School Buildings.

Text of a Report of Benjamin Richards, representing the National Fire Protection Association, on a Special Committee of the National Education Association appointed to prepare standards for schoolhouse planning and construction.*

This Committee is not as familiar as it should be with the work of school building standardization, not having followed carefully all the creditable accomplishments of the general committee. For this reason we present our suggestions with much fear and trembling hoping that they may not represent so wide a departure from the general committee's plan of action as to be unavailable for practical use.

Fire Protection of Schools.

A chart is presented with this report which is intended to show the general classification of the many features needing consideration in reviewing the requirements of fire protection of school buildings and their occupancy. We have tried to prepare this in such detail as to definitely fix the many items of hazardous occupancy and fire protection devices in their relative positions of importance and under their proper groupings.

Fire protection in its broadest sense and in its practical application to specific problems covers three principal branches—1, *Fire Prevention*; 2, *Fire Protection*; and 3, *Safety to Life*. *Fire prevention* recognizes the features tending to avoid fires, *fire protection*, the means for limiting their damage, and *safety to life* is inclusive of both in so far as they may apply to personal injury of the occupants of a building resulting from a fire therein. The first two branches, as applied to school buildings, do not differ materially from their application to industrial buildings. The Safety to Life branch, owing to the occupants being mostly children, requires special treatment with some departures from the practice usual to safeguarding the occupants of industrial buildings.

Fire Prevention.

1. Location.

Selection of a safe location for the building is of the first importance. The need for a school being often greatest in congested districts makes this a most difficult problem. Serious exposures from fire should be avoided, such as locations near hazardous industrial plants or defective wooden structures. Vacant lots are preferable but when these are not available corner lots may be selected. If the lot is exposed by brick buildings on one side and wood on the other it may be advisable to place the building nearer the lesser exposure.

* See Proceedings, N. F. P. A., 1918, page 286.

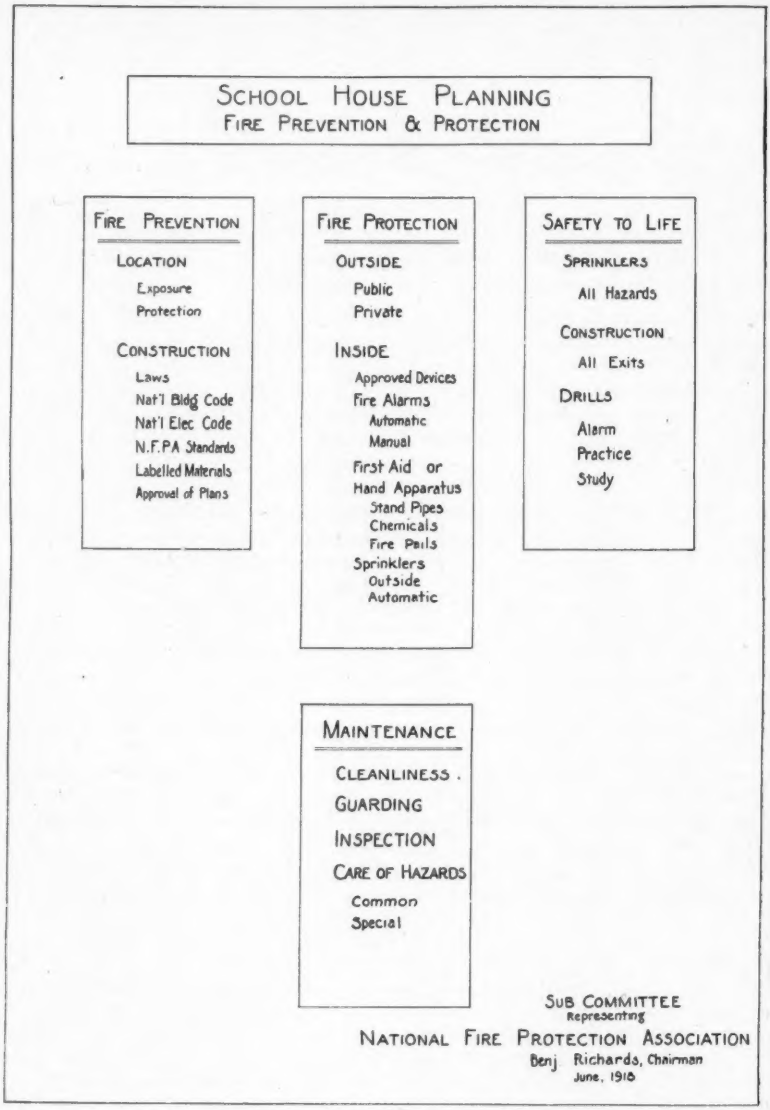


Chart showing classification of features needing consideration in connection with fire protection of schools.

The availability of a good public water supply should be considered in selecting a site. Large pipes, high pressures and an ample number of hydrants are the items to be considered.

2. Construction.

It is needless to say that the most fire-resistive type of construction possible under the circumstances should be used. All features of construction related in any way to fire prevention should be planned in strict conformity with the building laws and the suggestions contained in the National Building Code as recommended by the National Board of Fire Underwriters. The specifications of the National Electrical Code should control all electrical installations, and minor structural features such as roofings, fire windows, fire doors, should all be made under the standards of the National Fire Protection Association and bear the label of the Underwriters' Laboratories. In this connection we may point out that the Government has purchased millions of dollars' worth of goods, such as roofings, fire hose and electrical devices, under no other specifications than that they bear the label of the Underwriters' Laboratories. Engineers, in the employ of the Laboratories, are located in the factories producing labeled goods to guarantee the maintenance of the standards represented by the Laboratories' label. The Laboratories work in co-operation with the National Bureau of Standards.

Construction plans of school buildings may be submitted, with advantage, to the engineers of the local fire underwriters' association. Very often helpful advice or suggestions are available from this source.

The National Building Code specifies details for first class or fireproof construction, second class or open mill construction and third class or ordinary construction. It is possible to use open mill construction with that type of construction so desirable from the fire protection and safety to life points of view, the one-story building. All structural steel should be insulated and in third class construction metal lathing should be used in lieu of wooden laths.

Vertical communications are the *"bête noir"* of fire protection. They tend toward quick destruction of the building and loss of life. Elevators, ducts and all such flues connecting from floor to floor should be cut off and where practicable stairways should be similarly treated. Stairways from basements to the first story must be cut off for safety. The main stairways, with skill, can be designed with shut-offs between floors but under present conditions there is some value in the argument usually advanced that open stairways are essential to a quick exit by pupils and in low buildings are permissible. A properly protected building, however, will not call for the quick departure of the occupants which in itself is less safe than a moderate and orderly exit.

Fire Protection.

Fire protection has two main divisions—1, *Outside*, and 2, *Inside Protection*.

1. Outside Protection.

The first branch under this heading is Public Protection, which includes the fire protection furnished by the town or municipality and

is best attained in the selection of the site. This branch covers fire alarm service, which if adequate maintains a public fire alarm box at the school building, public fire department, and public water supply,—the latter being valued according to the size of the mains, pressure and location of hydrants.

The second division under outside protection is Private Protection. This should include one or more special hydrants located in the school yard and the hydrants should be covered with hose houses containing hose, nozzles, wrenches, a lantern and a fire axe. These are to make quick aid from hose streams possible and to avoid the possibility of injury to children passing from the building if the fire department should be required to lay hose in the usual manner. Hydrant houses may be designed to be ornamental, or if necessary the fire appliances may be kept in a place provided under steps or elsewhere in the main structure.

Where the building is unavoidably exposed severely from fire by a neighboring structure the windows on the exposed side should be approved fire windows of wired glass in metal frames.

2. Inside Protection.

All fire appliances used should be devices approved and labeled by the Underwriters' Laboratories in order that their reliability and quality may be assured.

a. Fire Alarms. Automatic alarms have not been used much in schools but as the fire hazards are rapidly being increased by the introduction of the industrial arts courses, kitchens, etc., it seems necessary to adopt this means of protection to insure the safety of the children and of the structure. Automatic alarms are thermostatic devices operative when the temperature of a room rises abnormally, and in a school they should operate a small alarm bell and an annunciator in the principal's room and be connected to the nearest public fire station. Thermostat equipments should cover the power plant, shops, closets and storage rooms, laboratories, the kitchen and libraries.

Manual fire alarms are now in general use and are fairly satisfactory. Their mechanical features need to be improved to effect greater reliability in many cases. They should be made operative from the power plant, basements, shops, offices, corridors and be readily accessible to all teachers.

b. First Aid or Hand Apparatus. This class of fire protection includes standpipes and hose, hand chemical extinguishers and fire pails.

There are national rules for the installation of standpipes which represent the best experience and thought on the subject. They are in too much detail to describe here but all contracts should specify that standpipes and their appurtenances be strictly in accordance with the N. F. P. A. standards. Small hose streams from internal standpipes can be handled easily by one person and give very effective fire protection. A good water supply with pressure in the standpipe at all times is essential. Standpipes should have hose outlets in the power plant, shops, corridors, and hall and on the stage if there be one.

Hand chemicals are in common use and are very effective on incipient fires. The standard 2½-gallon type which is operated by simply turning bottom upward should be used. These extinguishers require recharging with new acid and soda every year to maintain their full efficiency. They should be hung in readily accessible and prominent places in all corridors and rooms except class rooms.

Fire pails are very acceptable fire extinguishers when properly maintained. They should be painted red and marked "Fire." In the power plant, shops and kitchen they are especially desirable and they may be substituted for chemicals if desired.

c. Sprinklers. Automatic sprinklers have been long accepted as the most efficient form of fire extinguishing apparatus. Most schools could be equipped with sprinklers and thereby insure both safety to the building and safety to life.

When the school building is heavily exposed to fire in adjacent property the school windows on the exposed side can be protected by open sprinklers placed over the windows. These are turned on by hand and serve to keep neighboring fires from entering the building through the windows.

Automatic sprinkler systems if not covering the entire building should cover, where possible, all of the power plant, laboratories, shops, kitchen, stage, locker rooms, store rooms, and laundry. The entire system should be installed strictly in accordance with the N. F. P. A. standards. An adequate water supply is essential and an automatic sprinkler alarm should be included.

Safety to Life.

The very best means for guarding the lives of the children and other occupants of a school building is by the installation of an efficient automatic sprinkler system. Loss of life in sprinklered properties has been practically negligible. All hazardous rooms should be protected if a complete system cannot be installed.

The importance of good construction has already been pointed out. It is evident that the possibilities of escape from a building are in general proportionate to the speed of its combustion. The danger from smoke calls for special consideration from a life safety standpoint, so special care is necessary in planning exits. These details have not as yet been worked out but they will cover doors from rooms, width and lighting of corridors, halls, stairways and passages, etc. Inside steps, other than regular staircases are objectionable. One, two or three steps in vestibules and inside halls should be especially avoided. The first floor exit should preferably be on a level, or one step only below the general floor level and the approaches to the grade made by outside steps or ramps. Internal corridor and vestibule doors are also undesirable. Schools as a whole seem to lack liberal-sized outer doorways and approaches. The latter are especially important and should be laid out in recognition of the necessity for access by the fire department and the passing of the children from the premises at the same time. Where possible outer walks from main exits should not be laid out parallel to the walls of the building unless twenty feet away therefrom. Stairs should be of the

standard type and of a width to provide for but two pupils between hand rails.

Effort should be made to arrange the exits from the second floor directly to the outside instead of into the first story. This can be often accomplished without impairment to the architectural design by placing the outer doors at the half-way landing, the lower portion of the stairway being outside, open or in an open porch. Exits from the basement should be directly to the yard. Elevators should be in towers cut off by fire walls and standard fire doors.

Fire drills are a necessity in a school. They should be conducted with as little aid from the teachers as possible, the idea being to have the pupils act uniformly and automatically as a body. The same alarm should be used for drills and actual fires. Discipline and *irregular* practice are essential. We have added here a new element for safety "study." This calls for teaching occasionally, through reading or a lecture, something about the fire danger, its importance, its prevention and how it is fought.

Maintenance.

Maintenance affects all of the points covered above and it is of great importance. It is divided into three branches as follows:—

Cleanliness: This is the means for avoiding most fires. It is dependent on the janitor service and includes such details as waste cans, ash barrels, care of waste paper, etc. All waste paper and other waste should be kept in metal receptacles and not in canvas bags as is so often done.

Guarding: Important school buildings should never be left without the care of a reliable janitor or watchman. The statistics show that many school fires start after the janitor has left the building. Watchmen should be required to make regular rounds with records on an approved watchman's clock. Fences should be arranged with a view to guarding against malicious persons and to safety of exit from the yard. In high and trade schools the study courses could well lead to the organization of a school fire brigade to include principal, teachers and pupils, this brigade being organized and drilled to inspect for dangerous conditions, aid in the exit of the pupils, give the alarms and extinguish incipient fires. There are many possibilities in the fire brigade as an educational feature.

Inspection: The buildings, exits, fire alarms, hand apparatus, sprinklers and fire drills should be under frequent inspection by a special inspector employed by the city or by a regular fireman or his chief and also by the principal or local fire brigade previously described.

Fire Hazards.

Cleanliness, guarding and inspection have special reference to fire hazards which are in two classes, common and special.

Common hazards are those common to most properties, and for the school include boilers, heaters, fuel, ashes, electrical and gas apparatus and refuse.

Special hazards are those additional hazards incident to the occupancy of the building, and for the school include those of the laboratories, shops, kitchen, incinerator and laundry.

Fire protection though necessarily a subject of much detail has but few basic principles as shown by the main sub-divisions of the chart and this outline, and if these fundamentals are covered in the proposed standard for schoolhouses a marked improvement in the annual fire record against schools undoubtedly will be assured.

Strikes in Fire Departments.

The difficulty now experienced in attracting into the fire service men of the right calibre and the growing unrest among members of fire departments in all parts of the United States and Canada are facts which it is impossible to blink. Hardly a week passes without something on this subject in the journals which concern themselves with public fire protection. Such incidents as the struggle in Philadelphia over the introduction of the two platoon system, the demand for increased pay in Boston, following closely on the grant of one day off in three, the plans made by the city officials of Spokane for amending the civil service rules so as to permit the engagement in the open market of substitutes in the event of a walk-out of the firemen, are only symptomatic.

In view of the growing urgency of the whole problem particular interest attaches to the subjoined notes by members John L. Noble and Alexander Inch, who have had unusual opportunities of observing at close range the results of dissatisfaction in the fire service in localities where it has been most strikingly manifested. Mr. Noble's paper, though written some months ago, is still timely.

Fire Department Strikes and Unions.

By John L. Noble,
Secretary, Vancouver Island Fire Underwriters' Association.
(Member N. F. P. A.)

A condition of considerable undesirability is at the present time existing in various parts of the country and is the cause of much anxiety on the part of the public, and especially of fire underwriters.

The many civic councils and municipal administrative bodies throughout the country should realize the danger in allowing members of fire departments to become affiliated with labor unions.

There is no intention herein to comment on the advisability of trade and labor unions, their usefulness or otherwise, but certainly there should be no need for fire department employees to join forces with labor federations. Firemen should become such only on a distinct understanding as to their duties and the remuneration to be given. They certainly should not be reduced in pay during hard times. Experience has shown that during such periods the work of the fireman is increased. He is not a producer of commodities, but rather the guardian of such, so he never shares in any profits during good times, and no matter how hard the work is, nothing extra can be expected unless promotion is gained or a general increase ordered.

Undoubtedly the question of civic salaries is causing a great deal of anxious thought just now, and the difficulties surrounding the subject are on the increase as the days go by; on one hand we have organizations of ratepayers agitating for material reduction of civic expenditures, and on the other hand we have practically the whole staff of employees protesting that they cannot live on the present wages received. It would seem that our civic servants, especially firemen, must be given generous treatment if efficiency is to be the keyword throughout the public service.

Quite a number of fire departments recently have suffered a reduction in salaries, due no doubt to changes brought about by the present international crisis; and also, since the advent of such reductions, fire-fighters in different parts of the country have been approached by labor unionists to join their organizations. The arguments used by the unionists generally appeal to the wage-earner, and in consequence there is a grave situation facing Canada and the United States.

Without going into details regarding what has actually occurred during the past few months, nevertheless a few instances may be recorded to show that there is a tendency for firemen to settle their differences in a drastic way.

Not very long ago the City of Vancouver, B. C., Fire Department went on strike, and in the neighboring city of Victoria one was narrowly averted. Walla Walla (Washington) firemen also used this means to force their demands. While it is true that such conditions were not long-lived, it is not difficult to realize the gravity of such procedure.

Recently the City Commissioners of Calgary, Alberta, received a communication from the Calgary Fire-Fighters Federal Union submitting an agreement asking that the present wage scale continue till the end of the year, and that the electors be asked to vote on the two-platoon system at the next civic election.

The firemen in Portland, Oregon, have just completed the organization of a union, and it is expected that they will become affiliated with the American Federation of Labor. It is reported that the organization will be used as a lever to enforce a demand for a twenty-five per cent advance in wages and a reduction in working time. If the union is perfected a revival of the fight to establish the two-platoon system is contemplated, although this was rejected by the voters some months ago.

The action of the firemen in Tacoma, Wash., affords a striking example of the evil herein referred to. The fire-fighters there insisted on the two-platoon system or a general strike. The city budget having been completed for the year, no additional money could be secured until the following April. The charter of the city requires an emergency before the budget can be supplemented, and as it was ruled that the action of the department employees was not an emergency, the Commissioner of Public Safety was instructed to work out a plan for a double shift. In bringing about the required change the force, which was already undermanned, was divided into two, causing a very marked decrease in the efficiency of the department, the outcome being an increase of 15 per cent. on all fire insurance rates in the city.

These are only cited as a few instances of the spread of the trouble. There are numerous other communities in which similar conditions prevail, and it behooves those interested to seriously consider any intentions which fire departments may have in this connection. City fathers, however, must learn that money wisely spent in building up efficient fire protection is money earned; but at present fire protection is so closely associated with the idea of *saving* money that the real needs of this vitally important service are not adequately provided for.

The Winnipeg Fire Department Strike.

By Alexander Inch,
Inspector, Western Canada Fire Underwriters' Association.
(Member N. F. P. A.)

On Tuesday, May 14, 1918, most of the members of the Winnipeg Fire Department went out on strike; following is a brief review of the strike and events leading up to the trouble.

In April the municipal employees asked, through their union, for increased wages; the reply from the Board of Control was unsatisfactory to the unions, and on May 2nd the electricians went out on strike; this included the fire alarm operators and linemen; the central office was, however, kept in operation.

On May 3rd the waterworks men went out; this included repair men, valve and hydrant inspectors, etc., but the pumping station employees remained on duty. On May 4th a general strike was threatened, but nothing further was done until May 7th, when the teamsters employed by the Health Department went out.

The City Council then appointed a committee to deal with the union leaders and endeavor to reach an agreement. An agreement satisfactory to the unions was reached on Saturday night, May 11th, and was presented to the City Council for ratification at a meeting held on Monday evening, May 13th. The Council refused to ratify the agreement unless the unions would agree not to strike, but to settle all future differences by arbitration. Following the Council meeting, the unions met the same night, and the fire department was called out at 7.30 a. m. on Tuesday, May 14th.

At the time the strike was called a large fire was in progress, and the men engaged there remained on duty until the fire was extinguished. The chief, assistant and district chiefs and most of the captains and lieutenants refused to strike, leaving a total of thirty-two men on duty; these were concentrated at the central halls, and that night a number of volunteers offered their services, which enabled the department to keep the principal stations open, with a sufficient number of men to handle an ordinary fire; two small fires, apparently of incendiary origin, occurred that night, and several false alarms were turned in.

Next day steps were taken to get the department organized on a better basis; volunteers offered their services for both day and night duty for the duration of the strike and others offered for night duty only, with the result that in a short time eleven stations, out of the fifteen, were practically fully manned day and night, and an extra one was opened at night; an average of about one hundred volunteers were on duty continuously, and at night this number was considerably increased.

Through articles and advertisements in the newspapers, citizens were warned to exercise extra precautions, *and the city was remarkably free from fires during the strike.* In order to prevent false alarms, a large number of citizens volunteered to act as special constables to guard the fire-alarm boxes.

In the meantime the telephone operators were called out on May 15th; here again volunteers came forward, and in a short time the service was restored. Attempts were made to effect a settlement, but without result, and several other unions, including employees in railway shops, went out in sympathy. On May 22nd the street railwaymen struck, and from 12,000 to 15,000 men were then involved. Several other unions voted in favor of a sympathetic strike, but were not called out.

About this time Senator G. D. Robertson reached the city from Ottawa, and undertook to bring about a settlement. After some negotiations an agreement was reached, and on the afternoon of May 25th the men returned to work.

It was agreed that in future officers of the fire department should not be eligible for membership in the union and officers who are now members must resign. Future differences are to be first submitted to arbitration, and the strike used only as a last resort. If this agreement is adhered to and the fire department not called out on sympathetic strikes, there should be no more trouble of this nature. The object of the City Council in having the officers prohibited from joining the union was that in the event of a strike the officers would probably remain on duty and form the nucleus of a new department or a volunteer force to protect the city during the strike.

There are now 207 men on duty in 15 fire stations, and the fire alarm and waterworks men have all returned to work.

Through the courtesy of Fire Marshal E. M. Naylor (Member N. F. P. A.) and Fire Chief H. F. Magee we are able also to give some particulars regarding the strike at Dallas, Texas, in January, 1918. It appears that on January 8th, Chief Magee was informed that one com-

pany of 21 men had applied for and obtained a charter to organize a union in the fire department to affiliate with the American Federation of Labor and he reported accordingly to the city officials. The next morning the city officials notified this company of men that while no objection would be raised to the organization of an association among themselves to affiliate with other departments in a social way, a union among the members of the fire department to affiliate with the American Federation of Labor would not be tolerated. When asked if they would withdraw from the union, the members refused to do so, and the Mayor ordered them suspended from the service. In the afternoon of the same day a committee from the union called on the Mayor, advised him that unless the city officials would recognize the union and reinstate the members then suspended they would call a strike at 6:00 p. m. and the entire membership would walk out. The Mayor and officials refused to accede to their demands and at 6:00 about 90 per cent. of the membership, who had pledged themselves to support the union, went out on a strike.

The city officials and Chief Magee immediately commenced to organize a new department. They had 15 of the old men left and with the assistance of the Home Guards, 500 strong, they made rapid progress. In a couple of days the strikers began to realize that public sentiment was against them and a few of the astuter ones began to straggle back to save their jobs. Then the firemen's union collapsed.

The city officials and the Chief sitting as a trial board took up each man's case separately. If he agreed to withdraw from the union and pledged himself not to participate in anything of the kind during his connection with the fire department he was allowed to return to work. About thirty of the leaders, however, were refused reinstatement.

The department was subsequently reorganized, and while the strike was a disagreeable experience, the Chief considers that the department has been benefited by the ordeal, conditions for the welfare of the men having been improved, fire-fighting clothes, beds and bedding furnished, and $5.00 per month increase in salary granted since the strike. An application for another increase of like amount was pending before the Board of Commissioners at the beginning of June.

It is noteworthy that even in Dallas, where the attitude of the authorities on the subject of unionization was most uncompromisingly hostile, the need of better conditions was subsequently admitted and improvements were, in fact, introduced. So long as just grievances are permitted to exist, discontent and its resultant loss of efficiency are bound to continue, with the possibility of strikes at critical junctures. The possibilities of disaster involved in a fire department strike are too obvious for argument, and it would seem therefore a part of wisdom for those who have in the past shown the clearest appreciation of the problems of fire protection from the viewpoints of the property owner and the community, to take also into their purview at the present time the problems of human engineering involved in the organization and maintenance of a fire service under such conditions that the strike as a weapon would be ruled out not merely by the iron hand of prohibitory regulations, but by contentment and sense of responsibility of the men themselves.

How Army Hospitals Are Being Protected Against Fire.

Courtesy of Engineering News-Record.

Hospitals are a very necessary part of every army camp and cantonment today. More than that, they were among the first of the buildings that had to be completed in the early days of the war. Speed of construction was the controlling factor in their design, for they had to be ready to take patients as soon as troops were encamped. With this in mind, the engineers of the cantonment division existing then selected, under instructions from the Surgeon General's office (which had the deciding voice in the matter of hospitals), wood-frame buildings for the cantonment hospitals. The buildings are of the same general type as that adopted for the barracks. Such buildings are now in use.

When the first rush of construction was over, considerable attention was directed toward the fire-resisting qualities of the hospitals. Although they had protection equal to that of the other camp structures, they were criticised in some quarters for not being more fire-resistive, as would become buildings housing sick men who are more or less helpless. In view of this, steps were soon taken to improve the fire resistance of those hospitals already erected and to make certain changes in the design of the larger general hospitals which were to be erected mainly for the sick and wounded from overseas. The details of the changed designs and of the new hospitals are the subject of this article.

A drawing printed herewith shows the plan and layout of one of the general hospitals, and is typical in so far as the principles of design are concerned. This is the clearing hospital at Fox Hills, on Staten Island, in New York harbor. Provision is made for 1,500 beds, together with the many appurtenant buildings. A railroad spur brings trains to a storehouse group at the lower end of the site, which is on country sufficiently well broken up to require bending of roads and arrangement of the buildings to fit the contours. From the storehouses a switchback extends to the entrance of the hospital proper and to the power house which supplies heat and light. From the entrance roads extend to all parts of the grounds, so that each building or group of buildings can be reached by motor or wagon. The reader should note a distinction made on the drawing between these roads and the covered corridors which connect all the buildings, and over or under which the main roads pass. This will be described later.

The buildings in the group comprise the administration, nurses' and officers' units at the south middle part of the site, the receiving wards, the disinfecting buildings, the laundry, the mess and the kitchens near

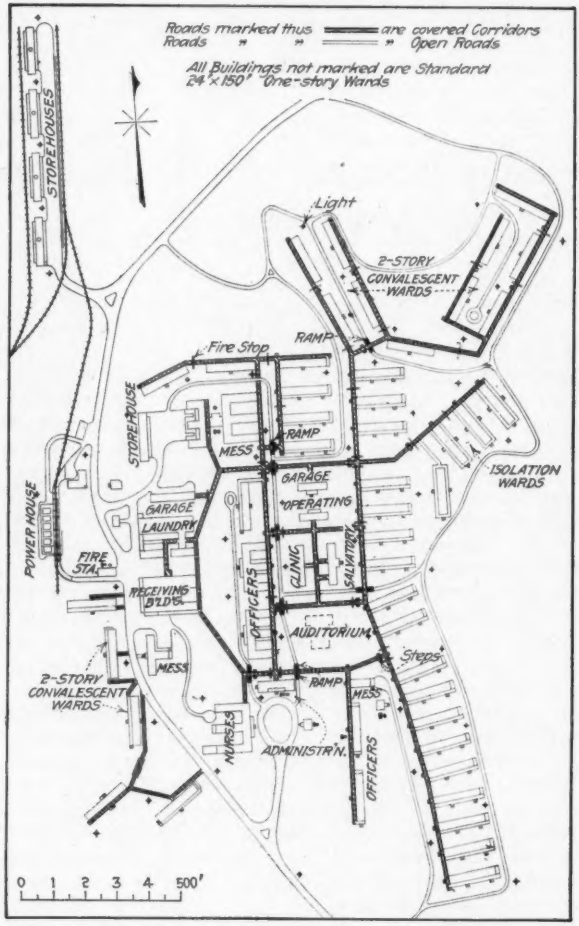


Fig. 1. Staten Island Hospital. Typical of layout of the towns where sick soldiers are cared for.

the entrance, the operating rooms, with the chambers for the clinics and laboratories about the center, the two-story convalescent wards at the extreme southwest and northeast, and the numerous standard one-story wards where most of the patients will be housed.

As a preliminary precaution against the spreading of fire, all buildings are placed well apart, the spacing depending on the size, construction and use of the structures. Thus, one-story frame wards, barracks and similar buildings not over 40 feet wide and 100 or more feet long

have a side-by-side spacing at least 50 feet and an end-to-end spacing at least 35 feet. Two-story wards over 30 by 100 feet in plans have side spacing of 80 feet or more, and end spacing at least 50 feet. The storehouses are more than 100 feet apart in each direction, and the laundries and the garages are at least 80 feet from other buildings. As shown on the plan, the wards are in groups with a minimum spacing of 150 feet between the groups. It is considered that this spacing reduces to a reasonably safe minimum the danger of fire in any one building spreading to others or sweeping over any considerable portion of the hospital area. In six months' experience with the cantonments, where such spacings have prevailed generally, there have only been three serious fires, and in each case the flames were confined to the building in which they originated.

One of the drawings herewith shows the details of the one-story wards which make up the bulk of the hospital and in which the seriously ill or wounded will be housed. It is a frame building, 156 feet long and 24 feet wide, with a porch, partly open and partly covered, on one of the sides. Studs of 2 x 4's sheathed on both sides with paper and board siding carry light wood trusses with standard composition roofing on 1-inch boards. At one end of the building is a glass-walled solarium and at the other end a partitioned section for the service rooms. Between is the open ward, with space for 32 beds. The numerous windows are plain-glazed, and four wide doors open on the porch and two on the corridor. Connecting with the porch and with the building itself is the covered corridor, which is inclosed for most of its length and which forms a continuous closed connection between all of the buildings on the site.

As a protection against fire in this ward building, the partitions are of plaster board, the ceilings are of the same material, the attic space is subdivided by continuous stops, the under floor space is continuously sheathed from ground to floor, and there are intermediate fire stops across the building below the floor. A detail of the fire stop in the attic and under the floor is shown on the drawing of the two-story ward, to be described later in this article. In addition, fire-resisting paint is specified where painting is required. All the lighting and heating pipes and wires are carefully insulated at all points of contact with the wood. Also, the doors are numerous enough and of such width as to permit the ready removal of all patients in their beds to the porch in a short time, and the porches are so near the ground as to make easy the carrying of the beds to the open air.

The corridors are all of frame construction, similar to that of the building. Connecting, as they do, adjacent buildings, they offer the easiest means for the spread of fire. In completed hospitals the hazard has been reduced by the interposition of a number of draft stops of plaster board or block, with fire-resistant doors, which are kept closed or are provided with automatic self-closing devices.

In the newer types of construction hollow tile walls have been substituted for the wood frame. Wards for convalescents are two-story buildings. At first these were of wood frame, similar in design to that

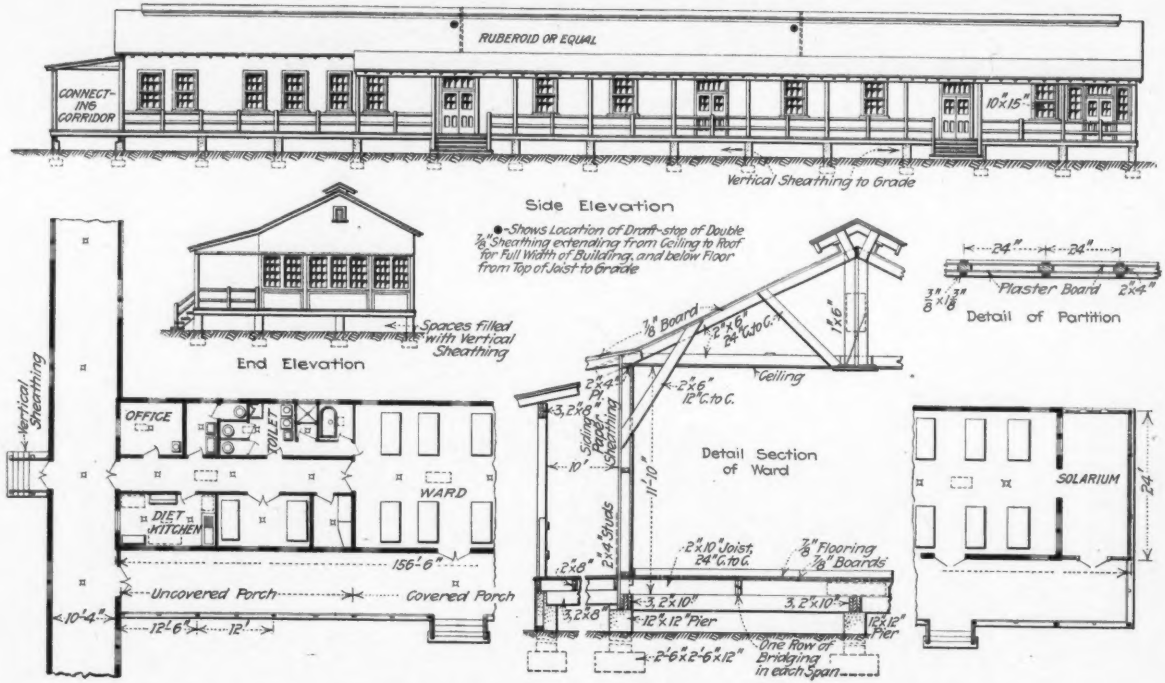


Fig. 2. One-story ward which houses 32 patients. Wood frame with ample exits and fire stops.

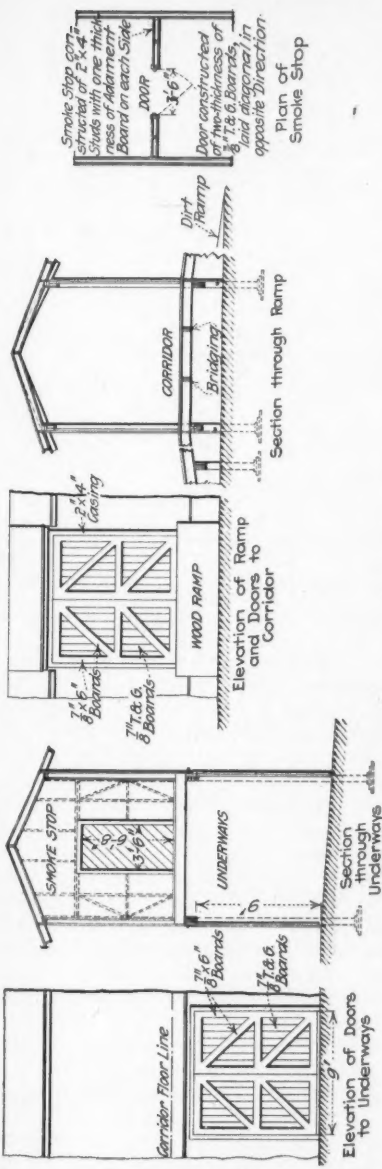


Fig. 3. Shows some of the changes made in old hospitals to reduce the fire hazard.

of the one-story ward. In the later design, however, the hollow tile construction shown in one of the drawings has been substituted. As an additional precaution, in such buildings there are two wide stairways leading down from the upper porch and one interior stairway completely enclosed in hollow tile partitions. These buildings have the same protection as the smaller ones in the matter of fire and draft stops, doors, paint, etc.

A complete fire-alarm system covers the whole site. This consists of automatic thermostatic alarms connected to the fire station and to administrative centers, and so arranged as to detect and locate any unwarranted rise in temperature.

As will be noticed from the plan of the Fox Hills hospital, the corridors cut off pretty thoroughly a large part of the interior of the site. To make all parts of all buildings accessible to the fire-fighting apparatus, the corridors are cut at proper places and the main roads are passed either over or under the corridor. At such places a rising or declining ramp leads the road either up to or under the corridor level, and the crossing is provided with a door, normally closed, but capable of being opened wide enough to permit the passage of the fire engine. At such crossings the spaces under the corridor are boarded off as fire stops.

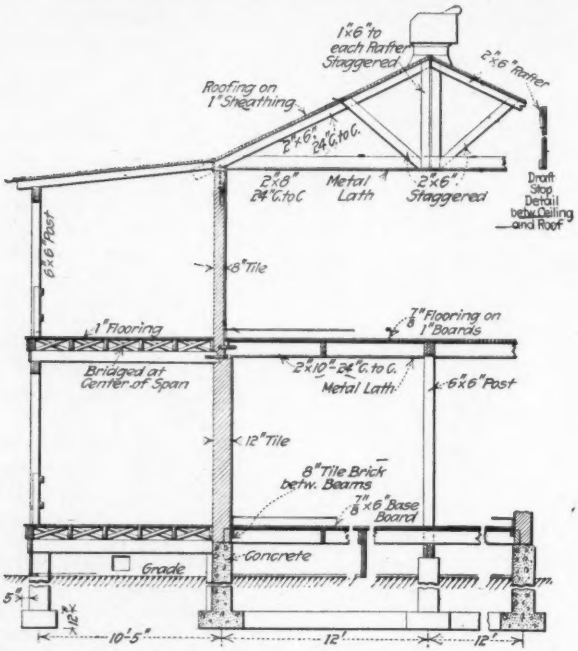


Fig. 4. Two-story ward with hollow tile walls.

In such of the older hospitals as had been completed without the taking of the precautionary measures noted above, protection against fire was later increased by certain structural measures. Some of these are shown on one of the accompanying drawings. Smoke stops, generally 150 feet apart and separating not less than two buildings, were placed across corridors. Draft stops were built at underways, additional doors were cut to the porches, extra steps were added, lights and signs were provided and complete fire-alarm systems installed. Ramps or underways affording entrance to interior spaces were put in where required. All of these additions, together with the painting of the composition board partitions with fire-resisting paint, were intended to make the old structures as nearly like the new as possible, without complete change of structure.

In one new hospital, that for tubercular patients at Denver, Colo., two-story hollow tile buildings of special design were used. This was done because of the difficulty of getting wood in that district. In the opinion of the Surgeon General, this hospital is of a more permanent nature, due to the fact that the patients there are apt to be confined for a long period and because in providing this hospital there was not the urgent need for speed there was in getting ready the hospitals for the sick soldiers at camps or for the wounded from overseas.

The basic requirements for the hospitals were laid down by the Surgeon General's office, United States Army, and that office has final supervision of the details. Those details were designed in the cantonment division, quartermaster department, now the construction division of the army, and the buildings were put up under the direction of the officers of that division. Engineers of the National Board of Fire Underwriters acted in an advisory capacity with regard to fire-protection and water-supply operations.

Influence of Ground Connections on Lightning Arrester Performance.

By E. M. Cohen.

Courtesy of Electrical Review.

The operation of a lightning arrester depends upon the functioning of the ground or earth connection. The best, in fact the ideal, lightning arrester may fail if the connection between it and the ground is not working because the ground wire is broken or because the resistance between arrester and earth has become excessively high.

In one instance to the writer's knowledge a number of arresters failed to protect the transformers in close proximity to them, and it was found that the earth wires had become corroded and finally broken off. The investment in lightning arresters was in this case utterly wasted because of lax inspection. Connecting up the earth with partially new ground wire overcame the trouble, an operation that would probably have prevented a financial loss out of all proportion to the cost of doing it.

In many instances—and this is more marked during the summer months—earth resistances increase. Thus a lightning arrester ground may be of low resistance during the winter and wet weather, but become one of high resistance during the hot weather when the soil is dried out by the combined influence of sun and absence of rain. In other instances the flow of dynamic current such as occurs when an arrester breaks down and allows current to flow from the line through the earth connection is responsible for drying out the earth around the earth connection, immediately increasing the resistance of the latter.

Much discussion has centered round the question of whether or not lightning arresters should be fused. On the other hand an earth connection that may vary with the seasons may introduce as great a degree of uncertainty as the arrester that may or may not be in circuit because its fuse may or may not be blown. Moreover, whereas the fuse is recognized as a variable, and one requiring vigilance, the earth resistance is in the majority of cases looked upon as something that remains constant, and thus usually is allowed to go uninspected. Many an invest-

ment in lightning arresters is not bringing in the return that might reasonably be expected from it because the arresters are improperly earthed. Also, the continuity of service, for which part of the arrester cost may be charged, is not as high as it would be were there efficient protection against lightning.

The season during which lightning is most severe is now here. Additional arresters probably cannot be readily obtained, and their price is high. It costs little and is well worth while to survey those already installed, to determine their condition and the condition of their ground connections, electrically and physically.

The Woolworth Building.

They will fashion their cities after you
When there is peace,
Pale glory in the mist,
White waterfall of granite
From heaven.

The Chlorates.

By F. M. Griswold.
(Member N. F. P. A.)

Interpreting the provisions of a recently enacted law covering the matter of "Regulating the Manufacturing, Distribution, Storage, Use, or Possession of Explosives and Their Ingredients," the United States Bureau of Mines classifies as an "explosive ingredient" "any chemical compound or mechanical mixture that contains any oxidizing or combustible units or their ingredients, in such proportions, quantities or packing that the ignition by fire, friction or by concussion, by percussion, or by detonation of, or any part of the compound or mixture may cause such a sudden generation of highly heated gases that the resultant gaseous pressures are capable of producing destructive effects on contiguous objects, or the destroying of life or limb," and specifically nominates as coming under this category the chlorates of barium, potassium, sodium and strontium, each of which is liable to ignition and explosion under any of the conditions mentioned, and, as an additional precaution, the law (Sec. 5) provides: "No person shall have in his possession, or purchase, accept, receive, sell, give, barter or otherwise dispose of or procure explosives or ingredients, except as provided in this act."

Attention is called to the enactment of this stringent and restrictive law in order to awaken a wider and more appreciative interest in guarding against the hazards brought about by the present necessity for the production of high explosives to meet the ever-increasing need for the prosecution of the present world-wide war, which has compelled a vast increase in the production of their basic ingredients, notably in relation to chlorates and nitrates, with the result that these basic compounds are being accumulated and stored in very large quantities at various points throughout the country, in many instances without discrimination as to locality or consideration as to the possible jeopardy to life or property by fire and explosion which must exist where such dangerous compounds are stored and handled.

Past experience has frequently demonstrated the dangerous instability of these compounds and their liability to bring about disaster under seemingly slight provocation, and recent fires and explosions due to their presence and handling serve to strongly emphasize the necessity for increased caution by those responsible for the storage and distribution of these materials.

While the hazards incident to the manufacture of chlorates may be considered as comparatively mild, this condition does not prevail in the matter of the finished product. All chlorates carry large percentages

of loosely combined oxygen content, and while it is generally assumed that pure chlorates are not inherently of an explosive nature, they are known to become so when in contact with organic matter and other substances; when subjected to the influence of friction, shock (as in crushing the hard lumps), concussion and percussion, and when heated to about 400° C. (752° F.) through the liberation of oxygen, which sometimes occurs in a violently explosive manner.

Even if, by chance, explosion does ensue from the ignition of the chlorate, the oxygen liberated serves to promote rapid combustion of contiguous organic matter and/or volatiles.

Chlorates are usually received from the factory packed in small hardwood kegs, iron hooped and paper lined, and of a capacity of about 100 pounds each; observation as to methods of handling and storage evidences the fact that the weight of the package and the assumed rigidity of its construction serves to induce carelessness in handling, with the average result that the shock and jar due to rough usage develops defects in the package through which more or less of the material escapes and is scattered over the floor, thus presenting ideal conditions for ignition from its being mixed with dust from abraded floors, friction due to contact with workmen's shoes, or a shock due to the forceful deposit of the iron-rimmed package into this mixture of wood dust and chlorate crystals serving perfectly to complete the mechanical combination productive of combustion.

In support of the statement that rough handling of chlorate packages is liable to cause ignition of the material, attention is called to the record of a fire and explosion which occurred at the Silver Spring Bleachery & Dye Works, Providence, R. I., February 19, 1896, where it is stated the explosion preceded the fire, being caused by friction set up through rolling or sliding the iron-bound kegs of chlorate over loose crystals lying on the floor and in contact with accumulated dust particles; fire ensued and remaining kegs of chlorate are said to have successively exploded.

The recent fire and explosion in the Jarvis warehouse in Jersey City, N. J., was ascribed to the careless throwing of a lighted cigarette on crystals of chlorate scattered over the floor, and it has been assumed that the glowing end of the cigarette ignited the chlorate; while this conclusion may serve in lieu of a better one, it is most probable that in attempting to extinguish the cigarette with pressure from his foot, the workman set up just that amount of force and friction necessary to induce ignition through this mechanical mixture of dust and chlorate crystals, and that continued effort to rub out the fire simply served to aggravate the conditions.

In support of the above explanation of the probable cause of the Jarvis warehouse fire in Jersey City, N. J., it is interesting to cite a fire of almost identical conditions which is recorded as having occurred in the storehouse of Thompson, Son & Williams, Hulme, Manchester, England, in 1908, and reported in the *Chemist and Druggist*, of London, wherein it was stated: "It appears that the warehouse contained many tons of chlorate of sodium, chlorate of potassium and chlorate of barium, stored in barrels lined with paper."

Major Cooper-Key, Chief Inspector of Explosives, who made an investigation of the disaster, reported that "a laborer, in reaching a winch handle, jumped from a barrel and struck a spark with his boot, and then saw a flame. Rubbing the place with his foot only made the flame worse, and soon afterward three explosions occurred." The Chief Inspector says he is of the opinion that the fire was undoubtedly started or caused by the friction of the laborer's boot on a mixture of chlorate of sodium or potassium and organic dust on the floor of the warehouse, the presence of this mixture being proved beyond question by the rapid spread of the flame when rubbed with the foot.

In view of this conclusion, the Chief Inspector suggested that handlers of chlorates "should render chances of accident still more remote by precautionary measures, such as:

1. The elimination, so far as may be possible, of combustible material in the packages containing chlorate.
2. The establishment of separate buildings, of fireproof construction, for the storage of chlorate.
3. Absolute cleanliness, *i. e.*, the outside of the kegs, the floor and walls of the store should be kept clear of all dust and dirt, and no one should enter the building in his ordinary boots. Either these should be taken off or 'overshoes' should be provided, as in a gunpowder magazine."

A proper observance and enforcement of these suggestions would serve to materially mitigate the dangers incident to handling these dangerous compounds under the general practice followed in the United States, but it should be borne in mind, in addition to the danger of ignition by friction or other mechanical action, that an equal and important hazard exists where these chlorates are not so carefully segregated as to prevent accidental or careless admixture or contact with other substances which are not compatible with them, such for instance as many organic substances of combustible nature, dangerous fluids, acids, acid producers and oxygen carriers.

Ready ignition and possible explosion may be produced by percussion when any of these chlorates "are mixed with such organic substances as sugar, meal, shellac, etc., and with charcoal, sulphur, or manganese dioxide (when warmed). With sulphuric acid; with potassium cyanide; with thiocyanates; with lead thiocyanate; with phosphorus, or antimony sulphide." (Von Schwartz.)

The disastrous fire and explosion at the Tarrant plant in New York City some years ago was ascribed to friction in handling raw chlorate, or in forming under mechanical pressure chlorate tablets containing sugar; a like fire and explosion occurred at the establishment of the Sharpe & Dohme Co., in Baltimore, where chlorate tablets (known as Santonin Crystals), made from pure and clean material, were being compressed on a rotary machine which previously had been used for the production of hundreds of tons of like tablets without accident; in this case the operator of the machine, a man of ten years' experience in the making of such tablets, met his death through the rupture of the device.

A peculiar and interesting incident showing the extreme sensitiveness and instability of chlorate of potash is on record, where the provoking cause is attributed to mild friction between the tablets wrapped

in paper and a penknife, carried together in the pocket of a man's clothing; supposedly, the jar incident to sitting down caused contact between the knife and the tablets, which became ignited and the man seriously burned before his clothing could be removed.

Chlorates are of great importance as bases in the manufacture of high explosives, and even where so apparently harmless a mixture as chlorate and sugar is made and subjected to a heat of 250° Fahrenheit, it explodes with extreme violence. Commenting on the conclusions reached after an investigation of an explosion which occurred in the Pain's fireworks factory (England), the *Chemist and Druggist,* of London (1889), states: "Chlorate of potash is the most explosive substance met with which chemists and druggists have to deal. By itself it seldom gives rise to serious accident, but the violence of its character is occasionally shown." * * * "The results are of interest as corroborating previous observations regarding the highly sensitive nature to percussion and friction of chlorates to mixtures, particularly at slightly elevated temperatures. The chemicals employed in the manufacture of the stars were found to be chlorates of barium and potassium, nitrate of strontium, shellac, coal, and charcoal." * * * "It was found, however, that one of the ingredients (Chertier's copper) of one of the stars was distinctly *acid,* and was the cause of the explosion."

When chlorates become ignited, large volumes of oxygen are liberated which adds to the rapidity and intensity of the flame, and the heat thus generated is liable to raise the temperature of contiguous substances to the point at which their volatile and combustible vapors or gases are freely given off and add to the intensity of combustion, and through combination with the oxygen, induce violent explosion; a like result would ensue through contact with charred or carbonized organic matter, such as wood, textile fabrics and the like falling into or upon the mass of heated chlorate; in support of this conclusion, reference is made to the very serious explosion which occurred as an "after effect of a fire" at the Kurtz's chemical works, St. Helens, England, May, 1899, where, in an action for damages due to the explosion, it was "decided that chlorate of potash is a dangerous explosive in the presence of fire; perhaps from the gases emitted by the molten material in admixture with gases liberated by the combustion of other material in the vicinity."

Ingle (The Chemistry of Fire and Fire Prevention—1900), commenting on this explosion, states that the fire did not originate in the chlorate, "where over 150 tons were stored in a pure state * * * the explosion, which was excessively violent (it was heard 27 miles off) was due to the effect of heat upon the chlorate itself," or was the result of contact with oil of vitriol, "which was stored in large quantities near at hand." * * * "Potassium chlorate is endothermic, and if the temperature of a large quantity of it were suddenly raised, the oxygen might be evolved explosively and the whole might then detonate."

Note on Chlorate of Potash.

(Potassium Chlorate)

By William J. Tallamy.

(Member N. F. P. A.)

In view of the many serious disasters that have been directly or indirectly attributable to the presence of chlorate of potash, the writer believes that a brief note on this substance may perhaps be instrumental in leading to a more general knowledge of its dangers, resulting in further restriction and more careful handling, both of which are necessary if a repetition of the disasters of the past is to be avoided.

Chlorate of potash, one of the important salts of chloric acid, is a white crystalline substance, usually handled in lump or powdered form.

It is produced largely by electrolytic decomposition of potassium chloride, though it may also be produced by passing chlorine gas through milk of lime and adding potassium to the mixture, or by adding chlorine to hot concentrated caustic potash.

It is composed chiefly of chlorine, potassium and oxygen, and will decompose with the liberation of oxygen from slight mechanical or chemical action, which fact is the chief cause of its danger.

Pure chlorate of potash will decompose and burst into flame with explosive tendency instantly if brought in contact with sulphuric acid, phosphorus, antimony sulphide, or potassium cyanide. Under ordinary conditions chlorate of potash gives off oxygen at about 350° C., the amount of oxygen increasing with the temperature, until a maximum of about 40 per cent oxygen gas is produced, potassium chloride remaining. Owing to its valuable properties its uses are many. In laboratories it is used in the production of oxygen gas. It is used extensively in the manufacture of fireworks, matches, colored fires, explosives, in fabric printing and bleaching establishments, and also for medicinal purposes. Hence the demand for it is great, and suitable provision must be made for handling and storing it.

Chlorate of potash should never be housed in the same building with organic or combustible substances, and premises in which it is to be stored should be thoroughly cleaned and free from any accumulation of particles of combustible material before the chlorate of potash is brought into the building. If, for example, a cargo of chlorate of potash in kegs be received into a warehouse that has been used for the storage of flour, starch, charcoal, sulphur, wood pulp, or any combustible material producing dust in handling, the mixture of small particles of chlorate of potash such as are likely to slip through the cracks and seams in the kegs and particles of inflammable dust remaining on the floor would be exceedingly dangerous and might easily be ignited by the frictional heat of a footstep, or by a smouldering match, cigarette or cigar.

Leaks from High Pressure Fire Service Mains.

By Henry B. Machen.*
(Member N. F. P. A.)

For many years water works officials have discussed leakage from distribution systems and the effect of changes in pressure without being able to come to definite conclusions, due to the fact that, except that for single supply lines laid generally under most favorable conditions, after the main has been placed in service it has been impossible to separate leakage from consumption.

The high pressure fire system in the Borough of Manhattan, New York City, due to the fact that New York has not permitted any private connection to its fire mains, gives an opportunity to make tests on a distribution system of 128 miles of mains, 2,728 hydrants and over 4,748 valves covering an area of 3,675 acres. The system has received during its ten years' life most trying tests. Each year it has had the pressure raised from say 35 pounds to from 125 to 250 pounds, an average of over two thousand times a year, due to fire alarms within the district, and for each period of twelve hours in duration during which no fire alarm has sounded the pressure has been raised for one-half hour to 200 pounds for testing out. It is hard to believe that any other water system in the world has gone through similar service conditions.

Table 1 gives in considerable detail the castings used, separated by contracts, by size of main and further sub-divided into full lengths of pipe of each size, offsets and bends of varying degree of curvature combined, 3-ways and 4-ways and short pieces. The short pieces were in many cases manufactured in the short lengths at the foundry; in other cases, they were cut from full lengths of pipe in the field. All castings used in the work except the pieces cut in the field were tested to 600 pounds at the foundry.

The 3-ways and the 4-ways were steel castings and considerable trouble was experienced at certain of the steel foundries in obtaining satisfactory castings. Two of the foundries, however, had practically no trouble in furnishing castings up to the specifications, the troubles of the others being due to lack of experience in this class of work.

The mains were all laid in the lower portion of Manhattan Island, where sub-surface conditions are most congested. This sub-surface congestion shows readily in the figures given in the table by the large number of bends and short pieces of pipe used, even after the city had

*Paper read before American Water Works Association, Richmond Convention, May 10, 1917.

Table 1.

Pipe and specials in the Manhattan high pressure fire system.

ITEMS	TOTALS ALL CONTRACTS	PER CENT
8 inch full lengths	437	3.2
8 inch bends and offsets	3,257	24.1
8 inch 3-ways and 4-ways	297	2.2
8 inch short pieces	9,533	70.5
Total	13,524	100.0
12 inch full lengths	26,729	64.8
12 inch bends and offsets	4,937	12.0
12 inch 3-ways, 4-ways	2,045	4.9
12 inch short pieces	7,563	18.3
Total	41,274	100.0
16 inch full lengths	9,561	64.8
16 inch bends and offsets	1,515	10.3
16 inch 3-ways, 4-ways	894	6.0
16 inch short pieces	2,783	18.9
Total	14,753	100.0
20 inch full lengths	3,894	62.3
20 inch bends and offsets	703	11.3
20 inch 3-ways, 4-ways	417	6.7
20 inch short pieces	1,233	19.7
Total	6,247	100.0
24 inch full lengths	3,513	65.1
24 inch bends and offsets	422	7.8
24 inch 3-ways, 4-ways	626	11.6
24 inch short pieces	838	15.5
Total	5,399	100.0
All sizes:		
Full lengths	44,134	54.4
Bends and offsets	10,834	13.3
3-ways, 4-ways	4,279	5.3
Short pieces	21,950	27.0
Total	81,197	100.0

availed itself of its right to order moved gas mains and other interfering sub-surface structures.

After the mains were laid they were subjected to an acceptance test of 450 pounds for a period of ten minutes for the earlier contracts and for twenty minutes for the later ones, the leakage being measured and for acceptance having to come within the limit of 4 gallons per linear foot of pipe joint per twenty-four hours. The results of these tests are shown in Table 2, which gives, separated into the same contracts, the linear feet of pipe laid of each size, the total linear feet of pipe joint, the allowable leakage, based on the specifications of 4 gallons per linear foot of joint per twenty-four hours, the actual leakage for the test period and reduced to the twenty-four hour basis.

Table 2.

Lengths of pipe and leakage in the Manhattan high pressure fire system.

ITEMS	CONTRACTS 6-7-8-9	CONTRACTS 19-20-21-22-23 27-28-29-30	TOTAL ALL CONTRACTS
24 inch pipe laid, linear feet	35,662.0	13,656.6	49,318.6
20 inch pipe laid, linear feet	29,849.8	26,330.0	56,179.8
16 inch pipe laid, linear feet	47,177.2	87,673.4	134,850.6
12 inch pipe laid, linear feet	154,466.1	224,429.0*	378,895.1*
8 inch pipe laid, linear feet	26,213.9	28,760.6	54,974.5
6 inch pipe laid, linear feet	860.0		860.0
Total pipe laid, linear feet	294,229.0	380,849.6	675,078.6
Linear feet of pipe joint	122,438	160,545	282,983
Allowable leakage for 24 hours	489,850	642,139	1,131,989
Actual leakage for 10 minutes	2,138.8		2,138.8
Actual leakage for 20 minutes		4,762.4	4,762.4
Actual leakage for 24 hours	307,741	343,391	651,132
Total number of tests	647	720	1,367
Date put in service	July, 1908 to November, 1909	July, 1910 to December 1914	July 1908 to December 1914

* Includes 150 feet of wrought iron pipe.

In testing, the test sections were in all cases between valves and doubtless a portion of the loss was due to water passing the valves limiting the section under test.

From the total column of Table 2 it will be seen that the mains were limited in the acceptance test of 450 pounds per square inch to a leakage at the rate of about 800 gallons per minute for the entire 128 miles. The actual gross leakage of all the tests was 452 gallons per minute. Today there is a leakage, as shown on the Venturi meters, of 950 gallons per minute at an average pressure of 33 pounds, or nearly double the amount of leakage at 450 pounds pressure at the tests from ten to four years ago.

Investigations have been made to locate the leaks, but due to lack of force the work has not been systematically carried on. However, due to the wide range in pressures, property owners have themselves

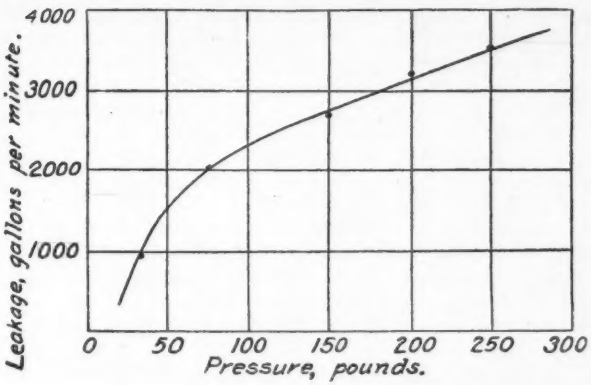


Fig. 1. Chart showing results of leakage test under varying pressure made on Manhattan high pressure fire system, December 8, 1916

reported eight connections which had been placed evidently by mistake. There may be others, not placed by mistake, in which advantage is taken of the higher pressures available at times to fill tanks. The occasional erratic movement of the pen in the Venturi chart may be an indication of this.

The author had until recently a very firm belief that the leakage was past the main valve of the hydrants and was carried off to the sewer through the drain pipe connecting the drip and sewer. This belief has been shattered by an aquaphone test of each hydrant made by a most careful and competent inspector who covered every one of the 2,728 hydrants and found but 51 (1.9 per cent.) on which any sound could be detected indicating leakage which could not be stopped by tightening the valves.

Of course, it might be said that a certain number of hydrants might be not tightly closed at all times in such a large number, but the system of maintenance is such that each hydrant is examined and repaired if necessary immediately after going out of service at a fire by an experienced machinist who reports to a follow-up system that the hydrant has been examined by him and left in good condition. The firemen, after an alarm, are the only users of the hydrants. Should any one else open a hydrant it is immediately known by an alarm bell operated by the Venturi meter recorder on the priming line.

During the past six years many miles of streets have been opened for the construction of the rapid transit subways, exposing over 54,000 linear feet of the high-pressure mains. No leakage has been found in the joints except an occasional sweat and from this evidence the Bureau of Water Supply is inclined to believe that the loss of water is not at the joints.

Fig. 1 gives the result of a test under varying pressure made on December 8, 1916. Attention is called to the almost straight line of

the upper portion of the curve, which seems to indicate that the leakage is not from fixed openings, from which a leakage varying as the square of the pressure should be expected.

It may be that the symmetrical results obtained and shown on the curve are but accidental; that as the pressure increased the main valves of the hydrants, which close under pressure, closed more tightly, reducing the leakage in the hydrant; that at the same time stuffing boxes in valves which are tight under low pressure might leak under the higher; that cracks in the pipe or steel casting not open under low pressure open under the higher.

Owing to a report of water coming in through the walls of a large sewer, there was located a split pipe which reduced the leakage under 35 pounds pressure by over 100 gallons a minute. This leak may have been of long duration, as at the time of starting excavations no indication existed at the street surface.

The author presents the above facts for the purpose of discussion and not as showing any definite conclusion as to leakage.

Planning Factory Water Supplies for Emergencies.

By Charles E. Worthington.
(Member N. F. P. A.)

There exists at the present moment a large manufacturing property with an up-to-date sprinkler equipment. It is an extensive property representing an investment of millions of dollars in an important industry, and even a serious interruption of its activities at this time would approach a calamity. It is not necessary to state what or where it is since it is typical of many others where conditions are almost precisely the same, and as no criticism is directed at this particular property in itself, identification is not desirable.

The plant in question embraces many buildings, some of very large area and many of good fire-resistive construction arranged regularly along streets or passages ranging from 30 to 50 feet in width, these "streets" and "passages" being wholly within the yard or premises, and private. All the buildings of consequence are sprinklered. There is a frontage on three streets, on all of which are gridiron public mains ranging from 8 inches to 16 inches in diameter. There are a good fire department with more than eight available steamers, fire alarm telegraph, and paved streets.

The water supply is threefold—first, city water taken from circulating mains at two points by 8-inch connections, the 8-inch private main forming a principal artery about 2,200 feet long, with one right angle, there being a secondary parallel 8-inch main well tied in with 6-inch and

8-inch crossings and some 6-inch branches. Second, an elevated gravity tank of 80,000 gallons capacity, with an elevation of about 150 feet connected in near the apex of the angle. Third, a 1,500-gallon duplex Underwriter pump in fire-resistive power house also connected in near one street connection. Street connections are properly checked off and all sprinkler systems and hydrants taken from the private main, with post gate control on sprinklers. Hydrants, standard 2 and 3-way with hose connections only, plenty of hose and a good mill brigade.

At first glance the equipment and water supplies appear almost redundant, but upon a further consideration we are not so sure.

The fire-resistive structures of large area contain in some cases considerable quick-burning contents, and the opening of as many as 100 sprinklers by one entirely controllable fire is not at all impossible—is, in fact, a conservative estimate. This number of sprinklers at an average discharge of 15 gallons per head would require the full capacity of the pump, with no margin for hydrant service.

It is not advisable to draw to any extent upon the tank. That piece of apparatus is a reserve service to give preliminary pressures and to serve as a main supply in case other apparatus fails during a fire. Its exhaustion in the earlier stages, therefore, would practically eliminate the service for which it is designed, and would be equivalent to throwing the reserves of an army into the firing line on the beginning of a battle.

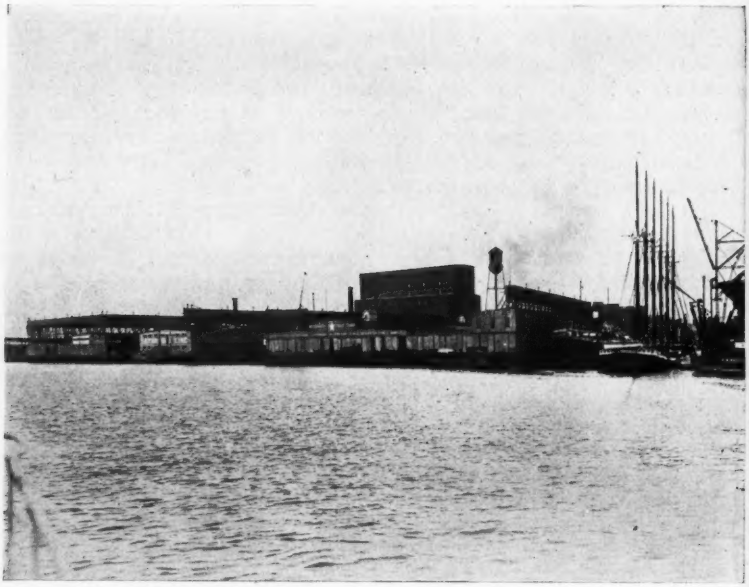
There remains then the city supply. Disregarding loss by friction in the city mains, the loss in the 8-inch main with a flow of 1,500 gallons would be destructive, while a reasonable probability exists that twice that amount might be desired for effective hydrant service.

It is fairly clear, or will be when the analysis is complete, that there is an error in the plans, and that error is confined solely to the size of the main private pipe, which, to provide for possible auxiliary supplies and reduce friction, should have been at least 10 inches, or preferably 12 inches in diameter. The larger size is necessary, not to take care of ordinary conditions, for which the 8-inch pipe is ample, but for extraordinary conditions, for the unexpected, and this without the slightest regard to the diameter of the supplying street mains; otherwise too much of the supply and energy available would be lost in friction.

Enter the chief of the local fire department, who in a manner recognizes that in the event of a severe fire both volume and pressure would be insufficient, but concerns himself chiefly with pressure, regarding volume only in a vague way. He has grasped the situation in part, but not fully.

His request is the substitution of hydrants having steamer connections for the pressure hydrants (a request which is diametrically opposed to the opinion of other chiefs, but perhaps illustrates the prevailing fire department idea), with a view to entering the private streets and connecting to these hydrants.

It is clear at the outset that this is a mere makeshift to get pressure at particular points, since the withdrawal of water by engine suction from the private main would reduce the pressure as much as a similar volume of withdrawal by other means, but would not increase the inflow



Courtesy Ludlow Valve Manufacturing Co.

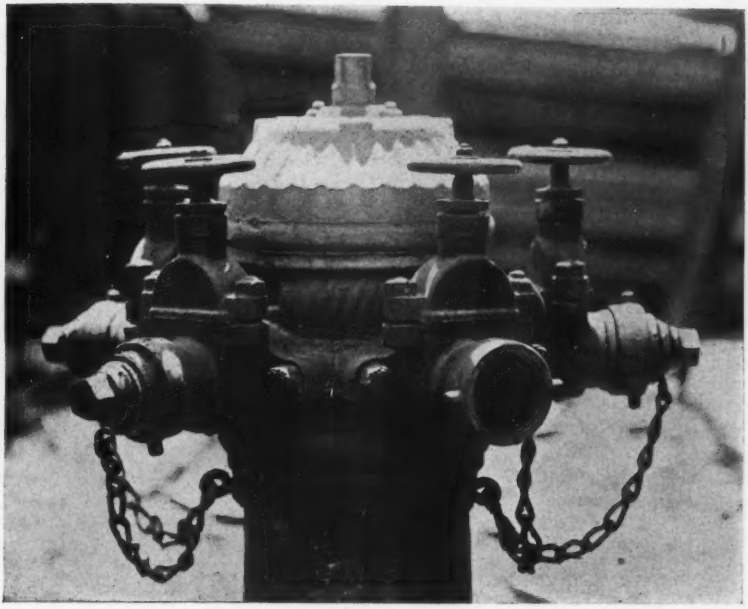
Fig. 1. Boston and Maine Railroad Docks and Grain Elevator at which "reverse hydrants" have been installed.

by a single gallon. It would simply be picking up water already on the premises to obtain pressure in a contingency where both volume and pressure are equally required, and if there is any advantage it is only partial.

But there are other unconsidered features. A pumping engine is a bulky apparatus, and even when stationed in an 80-foot street obstructs movement of apparatus in the street. In event of a severe factory fire, free movement within the yard is a prime essential, and the stationing of such apparatus would prove a very serious obstacle to the needed celerity of movements.

The pumping range of a steamer may be stated as 400-foot radius to secure good results—in practice it is less rather than more. Hence it might be necessary to move the engines now and then, each removal interrupting service and taking men from other work.

A steamer is a costly piece of apparatus, and its forced abandonment not only involves considerable loss, but it may cripple present operations and is certain to impair the fire department service more or less for some time. The stationing of engines under the walls of large buildings is a dangerous proposition. Steam operated pumping engines emit sparks and frequently originate new fires, while the smoke is always an unwelcome addition to existing smoke, and the noise is distracting.



Courtesy Ludlow Valve Manufacturing Co.

Fig. 2. "Reverse hydrant" showing female coupling.

It may be remarked in passing that the loss of from one to four steamers under somewhat similar conditions is not unknown.

A steam fire engine is merely a pump on wheels, and it can be applied to any uses appropriate to a pump of its class since, when once in use, it becomes for the time being a stationary pumping engine.

The objections to stationing steamers within the factory yard appear practically insurmountable, and ordinarily the need of so doing is not apparent, since the same engines may be stationed on the public streets and pump into the private mains, simultaneously raising the pressure at all points and increasing the volume of supply by introducing water that could not otherwise be brought into the mains.

The best method of doing this is by installing "reverse hydrants" at appropriate points, a "reverse hydrant" being a standard hydrant, 2-way or 4-way, *without steamer connections,* from which the usual male threads and couplings on the 2½-inch connections have been removed and female couplings substituted, thus permitting one or two engines to attach to the hydrant by short lines of hose, and pump *into* the hydrant instead of *drawing from it,* thus establishing for the time a direct high pressure local pumping system limited to the factory mains.

The arrangement is by no means a complicated one, and involves merely the placing of hydrants connected into the mains, each connec-

tion being checked off as well as the intake between the hydrant connection and the city main, *and* the establishment (usually) by the city or town of special service hydrants at an adjacent point.

These service hydrants are necessarily placed approximately 25 feet from the reverse hydrants and on the same side of the street to admit of use of 50-foot lengths of 2½-inch hose for connecting. They are simply ordinary hydrants with one or two steamer connections and *no* 2½-inch hose connections, the number of connections per hydrant and of hydrants being proportional to possible engines to be employed, which in turn depends on the sizes of mains. The method of connecting and arrangement of valves is shown on sketch below.

The advantages of the reverse hydrant over "siamese" are several. The form of apparatus is familiar to firemen, leaving only the fact of the "reverse" to be understood and memorized. The hydrants are self-draining and consequently always ready for use, and are not liable to derangement, requiring less care than ordinary hydrants, since they need not be "flushed." The cost of a 4-way hydrant is slightly less than that of a 4-way Siamese similarly connected, and the hydrant weathers better. Such hydrants should always be designated by conspicuous signs.

By this method every advantage of increased pressure is obtained, with the additional advantages of comparatively unobstructed streets and passages within the factory yard (a matter of very great importance). The water supply is increased; the safety of steamers is assured; there is no shutting down or removal when the locality of needed pressure changes; there is less delay in connecting in, and the additional noise and smoke and the spark hazard are avoided. *And the tank supply cannot be drawn down or exhausted by steamers.*

This method is applicable in degree to nearly all large factory equipments, and often may be substituted with advantage for Siamese directly connected to sprinklers, although, like any other method of supply, it is not universally applicable, and the need of competent engineering advice is not by any means eliminated, as many questions of ultimate capacity of mains and the like constantly arise that are not usually solvable by fire chiefs, since they concern details about which only engineers are generally well informed. It is always possible, however, to *push* more water through a pipe than you can *pull* through it. Nor is it new and untried, being in use with the strong approval of the fire departments in a number of large properties.

The service hydrants should always, if possible, be on the same side of the street as the reverse hydrants to avoid interruption to street traffic, and suitable instructions to fire companies as to coupling should be properly posted by the fire department.

It may be said in closing that the introduction of suction hydrants into a yard service which is supplied by a gravity tank appears essentially vicious in principle and involves "pumping in a circle," and that in any case taking water from the system within the yard merely to increase pressure at a single point is little better.

Increase of pressure uniformly supplied, coupled with an increase of volume, is always desirable, if only as an auxiliary, the use of which is not expected and is only probable in extremity. There cannot be too

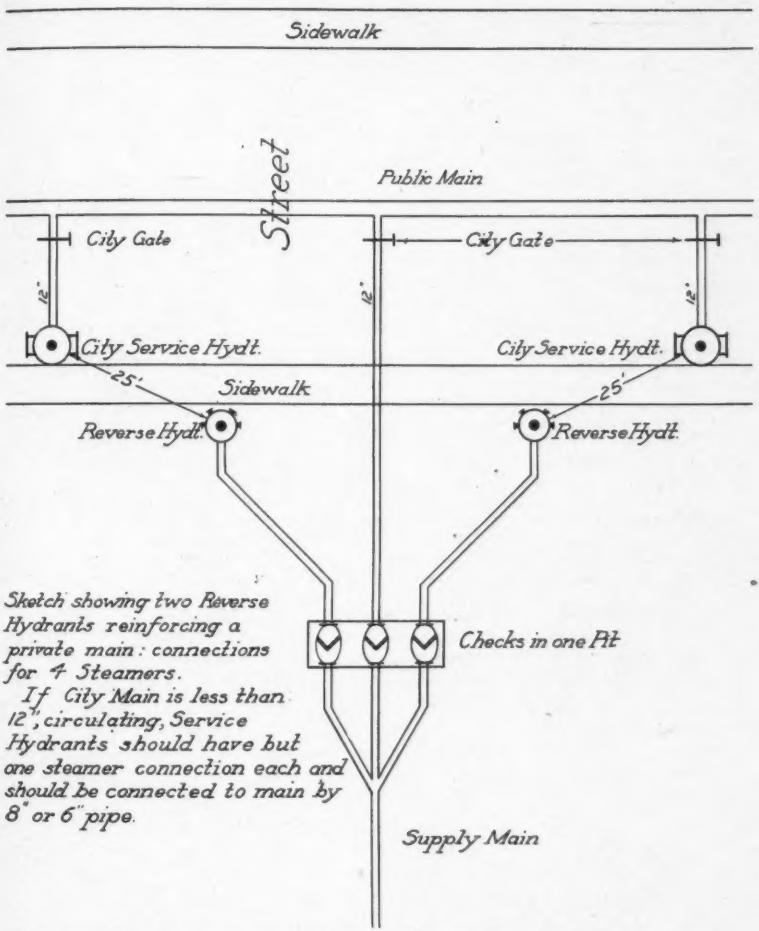


Fig. 3. Method of connecting and arrangement of valves with "reverse hydrants".

many resources, and the "ordinarily adequate" cannot be expected to provide for unanticipated but possible emergencies, and since the total expense of this auxiliary protection is very small, it would seem advisable to employ it more largely, even where its use is considered very improbable.

There is another important point connected with gravity tank supply. The functions of this tank are to furnish (in some cases) initial pressure and to act always as an equalizer and take up the supply when temporarily cut off—hence drawing down or emptying it *except for*

emergency or initial service puts it to improper use, and its limited capacity forbids such other use.

It seems needless to quote specific instances where serious loss has actually occurred because of drawing down tanks of from 50,000 to 100,000 gallons capacity, the supply giving out in the course of a fire. It has occurred in several cases, but mention of the oversight (since remedied) is unpleasant to all concerned.

The method outlined above can be used to success even when the main connection is a 6-inch connection from a 6-inch circulating main limiting to two engines taking suction from opposite side of intake, one main object being to get all the water there is to be obtained into the private mains where it will be of service and at high pressure.

As a matter of interest, a letter on this subject from an exceedingly competent official of a large city fire department is appended, merely as confirmatory evidence of advanced fire department attitude:

Boston, Mass., June 2, 1918.

MR. CHARLES WORTHINGTON.

Dear Sir:—In matter of fire protection for large industrial or manufacturing plants it is a well-known fact that efficient fire protection depends largely on the water supply, which must be ample under the most adverse conditions.

We have throughout the country many of these large manufacturing or producing plants that are equipped with sprinkler systems and local yard hydrants, dependent for supply upon take-offs from larger city mains. In many instances this supply and pressure are increased by auxiliary pumpage of limited capacity ranging from 750 to 1,500 gallons per minute. Superficially this may appear to have been sufficient, but in my experience I have found on several occasions such supply and pressure to be totally inadequate, especially when the water mains were not of sufficient size to properly supply the system under fire service conditions. Summing up the situation, this is a plain everyday mistake of the engineer installing. As a matter of fact, in an extensive plant at least a 12-inch main or —much better—a 16-inch main should do the work now expected of an 8-inch main, the difference in cost being negligible, the results ample.

It is a recognized fact that the elevated tank, gravity system, for sprinklers is the best for primary protection to stop or hold a fire in its incipiency.

I do not believe that it is the intention of any Chief to impair his reserves, but I know that he will do so if he connects fire engines to private hydrants in plant yards.

This would render the private pumps inefficient, in that the fire department steamers would be apt to draw enough water from the supply to weaken the much-needed pressures they could furnish, and doubtless would furnish, if the engines were assisting rather than retarding their effort by attaching to small mains within the yard. If the fire department steamers could connect to city service mains and push their capacity through "reverse" hydrants into mains located near the city service supply hydrants, you could expect an adequate supply both in volume and pressure to manipulate many more fire streams efficiently directly from the yard hydrants with much shorter hose lines, which means a tremendous saving in friction loss and more efficient nozzle pressures.

Two or three of these intake hydrants would be sufficient, as each hydrant would take the supply from two steamers; and each additional hydrant would mean at least two additional steamers. Assuming that each steamer or pumper could supply from 750 to 850 gallons per minute or more, it is a very simple matter to determine capacity needed.

With the "reverse" system located on our large manufacturing plants a high pressure would always be available, with the portable pumps (steamers) ready for immediate use. Long lines of hose would be eliminated; engines would be remote from the immediate vicinity of the fire; a clearance in and about the building on fire would thereby permit rapid maneuvering without hindrance to

the fire department. It would mean a reduction in further cause of fire from sparks from the steamers and in many ways lessen the anxiety of the chief in his work, and more satisfactory results would obtain.

I will say that we have, in our city, in operation a system such as you have described. To say that it is efficient is not enough. It is a success.

Remember one thing: The bleeding of any first aid invites calamity, especially where fire is concerned.

Respectfully,

JOHN O. TABER,
Senior Deputy Chief, Boston Fire Department.

New Hazards in the Rubber Industry.

Notes on the Manufacture of Rubber Heels and Soles, the Rubberizing of Cloth, Devulcanizing and their Hazards.

By Benjamin Richards,

Superintendent of Surveys, Underwriters' Bureau of New England,
(Member N. F. P. A.)

The recent marked growth in the rubber heel and sole industry is evidenced by the many new rubber mills whose whole product is limited to these shoe parts and by the adding of this line of goods to the output of mills heretofore operating on other rubber specialties.

The preparatory processes of a rubber heel and sole factory are in general those common to most rubber mills, such as soaking, washing and drying rubber, compounding, milling and calendering. These processes have been fully described from the fire insurance standpoint in other papers and need not be here reviewed.

Instead of cutting heels and soles from stock built up of several calendered sheets and fabrics as is done in rubber shoe factories, the new heels and soles are cut and moulded from thick sheets of rubber taken directly from the mills. The cutting is done by dies and presses in a manner similar to that by which heel lifts and soles are cut out of leather in a shoe shop. The roughed-out heels are then assembled with the small round nailing plates on steel or iron moulds. Several of these moulds are stacked in a press between hollow steam-heated plates and subjected to a hydraulic pressure of a little over 2,000 pounds per square inch, and at the same time vulcanized by the heat from the hollow plates which contain steam at 40 to 60 pounds pressure. The heels remain under pressure 10 or 12 minutes, the exact time varying with the size of the moulds and compounds used. After their removal from the presses, the edges of the heels are trimmed by rotary cutters to remove the surplus rubber which was squeezed between the dies. The heels are then boxed and packed for sale. The trade-mark or other design is embossed on the moulds used in the presses. The elaborateness of the necessary engraving to produce the figures governs the cost of the

dies materially. Moulds may contain 36 to 200 cavities (heels) according to the size of the heels, the latter figure being for the small half-heels applied to ladies' high-heeled shoes. The cost of the moulds approximates $2.50 per cavity.

Rubber heels have been on the market longer than rubber soles. The recent success of the latter has been due to the development of so-called "fibre" soles, the best of which appear to be superior to leather in wearing qualities and in addition have the advantage of being waterproof. Fibre soles are rubber soles containing a certain percentage of wool, cotton or leather fibre mixed with the rubber in compounding before vulcanization.

The fibre adds flexibility, lightness and strength to the soles. Good soles always contain fibre. Heels usually do not contain fibre. Soles are sometimes cut from sheets of vulcanized stock, but the best ones are vulcanized in moulds, as are heels. Some half-soles for use in tapping shoes without replacing the entire sole are being produced.

Rubber compounding is skillful work and varies greatly according to the product desired in a rubber mill. The different materials constituting the compound are varied to meet the requirements of quality, degree of vulcanization and purposes of the goods produced. Sulphur is always necessary to produce vulcanization but in cloth-coating work the sulphur is usually applied externally instead of being put into the compound. Rubber compounds before vulcanization are soft, more or less sticky masses in no form to be of permanent value. The chemical action of the sulphur on the rubber when heated constitutes what is known as vulcanization and produces the tough, durable finished rubber products with which, in various forms, we are familiar. This is mentioned only as a review. There are many papers giving the details of this subject.

Stocks for heels and soles are always prepared on mills. Churns, such as are used in cloth-coating factories for preparing soft stock, are not used for producing heels and soles. The amount of sulphur necessary for vulcanization is proportional to the amount of pure or reclaimed rubber in the compound, less being necessary for the reclaimed stock. The other ingredients of the compound are inserted for various purposes, such as to substitute for rubber, to add flexibility, hardness, color, wearing qualities, bulk, etc. The amount of fibre put into sole compounds varies from 10 to 25 per cent. Not over 5 per cent of leather fibre is used, the remainder being made up of wool or cotton. These latter are very short fibres similar to flocks. A compound for soles might be made up about as follows:

3 to 5 per cent leather.
5 to 15 per cent other fibre.
18 to 20 per cent new rubber.
5 to 7 per cent corn oil substitute.
2 to 5 per cent asphaltum.
10 to 25 per cent reclaimed rubber.
18 to 20 per cent zinc oxide.

1 to 6 per cent magnesium carbonate.
1 to 6 per cent sulphur.
whiting.
lithophane (pyrites and zinc)
litharge.

Some rubber is made by adding antimony sulphide to the compound, in which case very little sulphur is needed, as the antimony sulphide makes vulcanization possible. This produces a red rubber of superior quality. Inner tubes for automobile tires are often made from compounds containing antimony. All red rubber is not of this high grade, however, as any ordinary compounds may be colored red.

Rubber heel and sole factories are not so hazardous as ordinary rubber mills, as the naphtha hazard is not present. Churns and spreaders are not used. Most of the heel and sole factories, however, have a rubber reclaiming process which is hazardous and deserving of careful consideration in studying the fire danger in the industry.

Devulcanizing Soft Rubber Shoddy.

Very often the working up of old rubber is a part of the processes found in rubber heel and sole factories. This is especially common as regards the so-called "soft" rubber stock, such as old moulded tubing or automobile tire inner tubes, because the process of reclaiming this stock is comparatively simple. The reclaiming of the hard rubbers, such as old air-brake tubes, hose, shoes, automobile tires (outer shoes), etc., requires more extensive apparatus and more space, as it involves extracting the cotton cloth which comprises a large percentage of the stock. This is done by grinding, acid treating, carbonizing in dryers, washing and re-drying, or by an alkaline process in which caustic soda is used. This last process is only hazardous in the drying work.

The soft rubber, usually inner tubes, is prepared for mixing in the compounds for heels and soles by devulcanizing the stock and reducing it to a granulated form. The tubes are first cut into small pieces, and then this stock is mixed with some oxidizing oil in proportions varying from 7 to 15 per cent by weight. Corn oil is probably the best and most common oil used for this purpose, but cottonseed, rosin oil, neatsfoot, aniline, asphaltum oils or mixtures of them may be used. The oils are usually applied with a watering pot over the rubber spread out on the floor as stock is oiled in a woolen mill.

Corn oil is readily oxidized and is likely to produce spontaneous combustion if it becomes mixed with cotton rags or other such combustible materials by an action similar to, and possibly more intense than, that of linseed oil. Corn oil is used extensively in producing indurated fibre goods and linoleums. It is also found in foundries for making cores. It is being sold at present, in a refined condition, as a table and cooking oil.

After oiling, the rubber stock is spread out in large iron pans and the pans are placed in a devulcanizing chamber. This is usually a large cast-iron chamber, cylindrical in form, about 4 feet in diameter by 10 to 20 feet long. When the rubber is inserted the cover is closed and steam is applied at 60 to 90 pounds pressure for 8 or 10 hours, often longer.

When the rubber is removed it is in the form of a soft mass, sticky and sponge-like. Oil always acts on rubber to soften it and the steam heat hastens the action. It is said that little or no chemical action takes place, the devulcanizing being strictly a mechanical process. There appears to be no danger of fire in the devulcanizers when in operation.

The rubber from the devulcanizers contains 10 to 20 per cent. of water which has come from the condensed steam. This necessitates drying the stock and as it still contains the corn oil a marked fire hazard is involved in the process. Sometimes the oxidization in the dryers is planned as a part of the process of preparing the rubber. If allowed to stay in the dryers too long, the action of the oil produces fire in the rubber. There have been many fires, and some very severe ones, from this cause. Even if not placed in dryers the hot stock from the vulcanizers, if left long in a pile, will heat up and ignite. This whole process needs most careful supervision and watching to avoid fire as well as prevent injury to the stock. Fresh stock should be thoroughly cooled before it is packed in boxes or barrels.

The safest way to avoid this hazard is to mill out the water from the stock on the mill rolls, but this, involving power and labor, is more expensive than to operate the dryers. The amount of moisture, and, therefore, the drying hazard, may be materially reduced by providing covers for the trays in the devulcanizer so as to prevent largely the collection of condensed steam in the pans. Heat alone will devulcanize the stock without oil being used but the method takes a long time and is too expensive for general use.

By the use of asphaltum oils the process is safeguarded to some extent. Probably these do not give so good a product but it is said that up to 50% asphaltum oils may be safely used. No mineral oils of a paraffine base can be used for devulcanizing as such oils, being unstable (incomplete in oxygen), do not work well with rubber.

The amount of drying given the reclaimed stock varies greatly among different mills and the time seems to be based on the ideas of the various foremen rather than on scientific data. It has been noted that even in the same mill the night foreman and the day foreman had quite different ideas about the drying. It should be well recognized that drying at night is quite generally the custom, and the work is usually left in charge of the night watchman. Overheating, either by too much steam or by drying too long, results in fire. Stock cannot be allowed to remain in the dryer over Sundays, holidays, or for any other period exceeding ten hours without inviting a fire. These dryers should always be equipped with automatic sprinklers even if the dryer and stock trays are made of steel, which, of course, is preferable. The dried reclaimed stock is used in the compounds as a substitute, in part, for new rubber.

Cloth Coating.

Mills which rubberize cloth are more hazardous than rubber heel and sole factories. Cloth is usually coated on commission, the cloth being owned by outside parties. It may be single or double texture. Double texture cloths are two fabrics stuck together with rubber. Cloth coating involves the use of churns and spreaders and the vulcanizing

process is conducted in so-called "heaters," which are rooms in which the cloth is hung in folds. One heater may contain a value of from $500 to $5,000, depending on its size, and the value of the goods contained which range from cheap cottons to high-grade silks or worsteds.

The rubber is prepared for spreading on the cloth by mixing the compound in "churns" to form a thin mass like dough. Naphtha is used as a solvent to make the mass plastic and properly mix the ingredients. Sulphur is not often put into cloth coating compounds, this being usually later applied externally to the cloth in the heaters in the "curing" process. The stock is churned from 5 to 10 hours. The present Government work specifies a compound of 30% new rubber, 30% rubber substitute, and 40% filler, such as zinc and whiting.

Recently benzol has been used in a vulcanizing mixture through which the cloth is passed before it is placed in the heaters. This involves the use of this hazardous volatile in an open tank on a machine where static electricity may be produced. The process should be very carefully guarded.

The use of large quantities of naphtha as required in the churn room constitutes a severe and well-recognized fire hazard. Churn rooms should always be above grade, with no basement, and should be detached or without direct communication into the mill. There should be small pipes through the walls at the floor level so that naphtha vapors may drain outside. Methods of guarding this fire hazard have been fully covered in other publications. Buckets and pails should be avoided and the naphtha pumped directly to the churns. Some modern churn rooms have an apparatus for recovering naphtha from the churn vapors which materially reduces the hazard.

Spreaders are machines for spreading a thin coat of the plastic rubber compound from the churns upon cloth, drying it and evaporating to some extent the naphtha or other volatiles used in the compound. Most goods are run through a spreader two or more times, a very little rubber being applied at each run. Double-texture goods may be united on a spreader. The machine consists of a knife bearing on a roller over which the cloth passes, a series of steam coils which the cloth also passes over, and a winding mechanism at the end to roll up the product.

Spreader room fires are very frequent owing to the naphtha fumes freed from the cloth and the likelihood of their igniting from static electricity sparks generated by the friction of the cloth as it passes under the knife.

The most common method of extinguishing spreader fires is to blow them out with a steam jet. One-inch rubber hose under steam pressure can be applied effectively and quickly to extinguish these flash fires, as they pass over the surface of the cloth. The fires to a large extent may be avoided, although some must be expected in the best protected rooms.

Static sparks may be made less frequent by keeping the air of the room humid when the spreaders are operating. Dry, cold mornings are especially favorable to the production of static discharges. Maintenance of a high humidity avoids many fires.

Electric devices are on the market for neutralizing static electricity in such processes, and are proving quite successful.

It is desirable to remove the naphtha fumes from the room to make it more habitable for employees, as well as to safeguard it from fire. One of the best methods of doing this is to provide exhaust tubes with openings on the floor level, below the spreaders, the tubes being connected to a trunk line of strong tubing from which the naphtha is exhausted by a fan to the outer air. As naphtha vapors are heavier than air, it is essential to success that the openings to the tubes be at the floor level, and the tube should be graded downward, with the fan and its discharge outlet at the lowest point in the system if possible. The outlet should be guarded and located well away from fires or other source of possible ignition.

Another method of removing the naphtha which is successful is to collect the naphtha vapors from the spreaders in hoods which are piped off to a condensing apparatus which recovers the naphtha for use again. This system is also used for recovering the evaporation from churns.

Heaters.

Heaters, as a rule, are wooden structures, usually lined with metal having steam coils at the bottom like an ordinary dry room. They are 6 to 10 feet high, and may be anywhere from 6 to 20 feet wide and 10 to 50 feet long. Most of them are about 10 by 20 feet. The coated cloth is hung in the heaters on sticks, or steel rods, in vertical folds above the steam pipes. The purpose of the heater is to vulcanize or "cure" the rubber on the cloth, which is usually done with sulphur gas and heat. A temperature of about 120° is usually applied for light, single-texture goods. Too much heat devulcanizes the rubber and spoils the product.

Usually in compounding the rubber for lightly coating or impregnating fabrics the sulphur is omitted from the compound. This is applied to the cloth externally in the form of a gas by placing in the heater small crucibles containing sulphur chloride, the curing medium. To this is usually added a little carbon disulphide or carbon tetrachloride. Where the former is used there is, of course, a marked fire hazard in its presence. The cloth is subjected to the fumes for from 15 to 30 minutes, after which the heater is opened or otherwise ventilated to remove the gases. Then ammonia fumes are applied for a few minutes in order to neutralize remaining chemicals in the cloth. The cloth is then removed by winding into a roll and is ready for inspecting, folding and packing. Sometimes a "velvet" finish is given the cloth by applying starch to the goods after coating, but before curing. There might be a slight starch explosion hazard in the starching machine or starching room. The light goods are generally coated at a cost of about two cents per coat per yard, and five to ten coatings may be applied. The waste is about 1 per cent. In double-texture goods more coatings are usually applied to the linings than the face fabric before they are united. Heavily coated goods and sometimes double-texture goods are vulcanized in so-called "dry heaters," in which case the sulphur is worked into the compound and heat only is applied, the goods being subjected to about 240° temperature.

The fire hazard of the heater or curing process, aside from the use of carbon disulphide, as previously mentioned, varies with the presence of gasolene fumes given off by the cloth. Heretofore high-grade naphtha or gasolene was used, and most of the fumes were diffused at the spreader and while the wet cloth was being placed in the heater, but of late heavier solvents, as low as 54° gasolene, have been used in the churns. These heavy vapors do not so readily pass off in the process of spreading and the subsequent handling of the cloth, so that it is quite possible that the heater will be closed and the steam applied with a large amount of inflammable vapor still within the heater. There have been some explosions and severe fires from this cause. It has been the usual custom not to install automatic sprinklers inside the heaters, but this should always be done, not only in accordance with the long recognized principle of fire protection that all large enclosed areas not accessible to water from the ceiling sprinklers should be equipped, but also to guard effectively the marked danger from the use of the lower grade volatiles. As a further safeguard, all heaters should be provided with an exhaust fan with its suction connected at the floor level of the heater, and always before the steam is applied the vapors should be exhausted by the fan. If the benzol process mentioned above is used, the safeguarding of the heaters is essential.

Department of Fire Record.

Fuel Oil Hazards — Fire Record.

The present study of the hazards of fuel oil systems is an experiment made at the suggestion of a member having wide experience of inspection work. The industrial fire records previously published have made available comprehensive data regarding the hazards specially requiring to be safeguarded in different classes of property. It is now desired to analyze the special hazards themselves. Many of these are common to several industries, and, while the particular points of danger they present are, of course, widely known, it is believed that a survey of fires occurring over a wide field may bring out facts not generally realized as to the relative importance of different features.

The intention also is to provide in a convenient form material that will be of service to inspectors making recommendations to property owners. It may easily happen, from a variety of causes, that the gravity of a particular hazard may not be apparent from its effects in some one industry, and in such cases a summary of the experience with that hazard in other industries should be helpful.

In the present instance the facts thrown into relief are that the hazards of insufficiently protected piping, etc., are very imperfectly understood in many plants, that installations are not as thoroughly and frequently inspected for defects as is necessary for safety, and that employees engaged in operating fuel oil systems often do not receive proper instruction as to the consequences that are likely to ensue not only to the plant but to themselves if they fail to exercise the greatest caution at all times.

Reference to the details of the causes will show how serious is the danger to unprotected pipes from the carelessness of workmen engaged on jobs unconnected with the oil system, such as structural alterations or repairs, removal of goods, etc. Even the most careful supervision is more likely to fail at a critical moment than are mechanical safeguards where these can be provided. The provision of automatic shut-offs for the oil supply in case of breakage of pipes or excessive leakage, as recommended in the standard regulations for the installation of oil burning equipments, would undoubtedly have reduced the seriousness of several of the fires recorded. Attempts on the part of incompetent or inexperienced employees to remedy leaks, etc., should never be permitted.

It would be very interesting to know whether records of this type would be widely appreciated as a variant upon the industrial records with which readers of the QUARTERLY are familiar. If so, improvements and elaborations of form will doubtless occur to those by whom the records will be used. The co-operation of members by way of suggestion or criticism is therefore invited.

Fuel Oil System Fires.

1. Classification of Plants and Analysis of Loss.

	Large Loss.	Small Loss.	No Claim.	No Data.	Total.
Agricultural Implement Factories	2	4	2	..	8
Automobile and Bicycle Factories	..	1	1	1	3
Bolt, Nut and Screw Works	..	..	1	..	1
Car Works	..	2	4	..	6
Carriage Factories	..	1	2	..	3
Cutlery and Tool Factories	1	4	..	..	5
Forges (separate)	1	2	..	2	5
Foundries	1	5	1	1	8
Machine Shops	1	18	..	..	19
Metal Workers not otherwise classified	2	28	4	5	39
Munitions Factories	1	2	..	..	3
Rolling Mills	..	..	2	..	2
Total	9	67	17	9	102

2. Details of Causes.

	No. of Fires.	Per Cent. of Whole.
Broken pipes	26	25.5
Broken and defective fittings and valves	12	11.7
Carelessness with valves	11	10.8
Overheated oil furnaces	7	6.9
Miscellaneous carelessness	7	6.9
Broken and defective burners and burner connections	5	4.9
Leaking pipes	5	4.9
Sparks or flame from oil furnaces	5	4.9
Explosions in furnaces	4	3.9
Clogging of pipes, obstructions to burners	4	3.9
Oil getting into air pipes	3	2.9
Defective or improperly installed tanks	3	2.9
Explosions in tanks	2	2.0
Oil soot ignited in flue	1	1.0
Data lacking	7	6.9
Total	102	100.0

Details of Causes.

Broken Pipes and Fittings.

H-1107. Oil escaped from broken pipe at "L" joint near furnace. It is thought that the joint had been leaking and that the break resulted from the effort of an employee to remedy the defect. No data as to loss.

H-3273. The apparatus was sub-standard and was discarded after the fire. Loss $250.

H-5274. Fuel oil pipe burst under air pressure over rivet forge. The building was brick, light joisted construction, frame roof, with monitor extending the entire length of the building. Line shafting and timbers supporting it were so saturated with oil that although the fire started about 50 feet from the rear of the building, it took only 3 minutes to spread to the front, a distance of 250 feet. The loss exceeded $75,600.

H-8248. An employee pushing a truck loaded with castings which projected over its edge, collided with a crude oil supply pipe, breaking the same close to the ground near a riveting furnace. The escaping oil was ignited by the furnace and a loss of nearly $22,000 ensued. The air pressure on the pipe at the time of the fire was from 70 to 75 lbs.

H-8268. At this plant the tempering furnaces were brick set and so arranged that the back burners were only used when extra long material was to be heated, as on the morning of the fire. As the foreman turned on the rear burners he saw a fine spray of oil flowing back against a heavy plank partition built about 2 feet from the side of the furnace. Before the local valve could be operated, the escaping oil took fire from a burner already alight. Promptly shutting off the oil supply and using chemical extinguishers and hose, the employees soon had the fire extinguished except in the roof, where the fire department had little difficulty in completing the extinguishment. The cause of the trouble was a split union. The globe valve controlling the flow of oil to the burners was bronze and to this was screwed a brass union which in turn held the oil nozzle. The shoulder of the movable part of the union had become split, probably through having too great a strain put upon it.

H-9411. Long steel channels were bent in the building in which fire occurred. One of the channels came in contact with a small fuel oil feeder pipe on the heating furnace. There was a series of such ¼-inch pipes coming up from a larger pipe underground. Although only one of the pipes was broken, the oil, which was under 80 lbs. air pressure, shot high in the air, catching fire from other burners. The loss was about $1,800.

H-10214. While a fuel oil furnace in the smith shop was being moved, a ⅜-inch pipe was struck and broken off at the elbow at the floor level. The system carried 60 lbs. oil pressure and was controlled from a valve in a pipe tunnel at the north end of the building. Before this valve could be closed the oil became ignited from a furnace and set fire to a double door in the rear of the furnace. The sheet steel which protected the lower part of the doors was heated sufficiently to warp the doors badly, and the upper portion and transom overhead were also damaged.

H-11843. A fuel oil burner was used for drying bull foundry ladles. The ½-inch supply pipe to the burner was broken either by careless handling of a ladle or by crane gear swinging against it. The escaping oil ignited and the flames set fire to roof joists 15 feet above. Only prompt and efficient work by the private fire brigade prevented serious damage.

H-11935. Furnace doors were operated by a chain passing over pulleys counterbalanced by weights hanging at the back of the furnace. Probably as a result of vibration one of the weights fell and broke a ⅜-inch feed pipe. Escaping oil was ignited under furnace. The loss was about $2,000 and would have been much greater but for good work by the furnace men with hose.

H-12012. The fuel oil pump in the boiler room was left running after the furnaces were shut down, and the resulting excessive pressure broke a union in the pipe supplying a furnace in another part of the plant. The escaping oil was ignited by yet another furnace. The loss was $500.

H-12740. An employee repairing an oil furnace which was still hot stepped on an oil supply pipe and broke it. Heat from the furnace ignited the oil with the result that many windows were broken and some temporary wooden hanger timbers on the ceiling were charred. More important than the $300 property loss was the severe burning of three employees.

H-12758. A considerable amount of temporary piping was installed in connection with the fuel oil system, the piping inside the building near the furnaces being seriously exposed. Masons rebuilding one of the open hearth furnaces accidently dropped bricks on a temporary pipe, rupturing it. The escaping oil under 90 to 100 lbs. pressure was ignited by a furnace and burned furiously. The building was all metal construction and the damage was slight.

S-7365. Workmen were erecting a new tank, which slipped and broke the feed pipe to a fuel oil furnace, causing the oil to spread considerably before the pump could be shut off. The loss was small.

S-8243. While a burner in a fuel oil furnace was being removed the feed pipe burst, allowing oil to run freely into the furnace where it immediately burst into flame. The oil feed was shut off as soon as possible, but notwithstanding the operation of six

sprinklers the fire had begun to eat into the roof and through wooden shutters over a brick wall into the adjoining forge shop. One sprinkler operated in this forge shop and prevented fire from spreading further.

S-10049. Case hardening furnaces were heated by fuel oil burners supplied from a partially buried tank outside the building. From the tank the oil was pumped to a small standpipe in the building, whence it passed to the burners through a 1-inch feed pipe. The latter pipe broke off in the thread at one of the fitting joints. The escaping oil was ignited by the furnace and burned so rapidly that the walls of the building were badly damaged and the roof nearly destroyed before the fire was extinguished. There was no apparent reason for the break as the oil pressure in the pipe was only 12 lbs. There were no sprinklers in the building where fire started, but open sprinklers did good work in protecting the main building of the plant. About $1,500 damage was done.

S-18459. A ladle containing molten steel broke as it was being moved, allowing the hot metal to run on the floor. A traveling crane was brought, and in using this a ½-inch oil pipe was broken above the inside shut-off valve. The oil which was under 30 lbs. air pressure came in contact with the hot metal and flared up to the roof. The flame was blown over a considerable area of the ceiling, as the building was of large extent and doors were open at both ends. Some minutes elapsed before the main outside valve controlling the flow of oil could be closed. Eighty-nine sprinklers operated and held the fire in check. The loss was $1,200.

S-18996. $150 loss followed the breaking of an oil pipe near a furnace when it was struck by an object suspended from a traveling crane. In this case the oil was shut off and the fire extinguished before the arrival of the fire department.

S-19186. While changes were being made in one of the buildings at this plant, a fuel oil pipe was accidently broken by a workman using a bar. The oil ignited but was shut off promptly and the damage amounted only to $126.

Carelessness with Valves.

S-13687. Employee was preparing his furnace for the afternoon work and had thrown into the furnace a bunch of oil-soaked waste to ignite the oil from the burners. He then turned on a burner at one side of the furnace and, getting no flow of oil, jumped to the conclusion that the burner was plugged. Leaving this burner wide open, he went to the other side and turned on another burner. In the meantime another employee had discovered the real reason of the failure of the oil, viz., that the belt on the pulley driving the oil pump had slipped off. He at once replaced the belt, thus throwing a considerable quantity of oil into the furnace which was quite warm from the morning's work. The result was a great burst of flame which leaped to the wooden rafters and trusses of the roof a few

feet above. This section of the plant being an unsprinklered portion, and the construction being largely of wood, the fire was not extinguished until damage had been done to the extent of $25,000.

S-18295. Fire was discovered by a watchman at 4.35 a. m. at an oil furnace. Both air and oil valves were found half open, so that the oil had run out over the floor, which here consisted of planks laid on cinders and was covered with plates, structural work in process of erection, etc., preventing the ready discovery of the leakage. What caused the oil to ignite is not known. The damage amounted to $100.

H-11974. Workmen at a furnace noticed that the oil supply had diminished, due to the closing down of the pump. They at once opened the valve wide, and at the same moment the pump started up again, resulting in an excessive flow of oil being delivered at the burner. Some of the oil ran down the side of the furnace and ignited a wooden partition about a foot distant. This partition extended from the floor to the roof and the flames spread rapidly through the roof, causing a total damage of between $1,500 and $1,800.

Improperly Installed Tanks.

S-15428. A fuel oil tank was located in one corner of a structural shop, a furnace some distance away being used for heating rivets. An employee was endeavoring to stop a leak around a plug in the tank by tightening the plug with a wrench. The oil, being under pressure, forced out the plug, and was discharged into the shop. It was ignited by a red hot rivet which was being handled by a boy with tongs, and set fire to the boy's clothes and those of an old man standing nearby. Both were fatally burned. The property loss was $550.

H-12813. Oil-burning rivet heaters were supplied from tanks of five gallons capacity right under the fire box, and were used under pressures up to 60 lbs. One of the tanks opened up at a seam and the fire at the burners jumped back to the escaping oil. The loss was slight.

S-9678. A fuel oil tank was located on the second floor, supplying by gravity a furnace in the room below. In attempting to fill this tank through a funnel on the floor above an employee neglected to remove the cover, and oil ran down the side wall and was ignited by a gas-heated furnace. The damage amounted to $2,000.

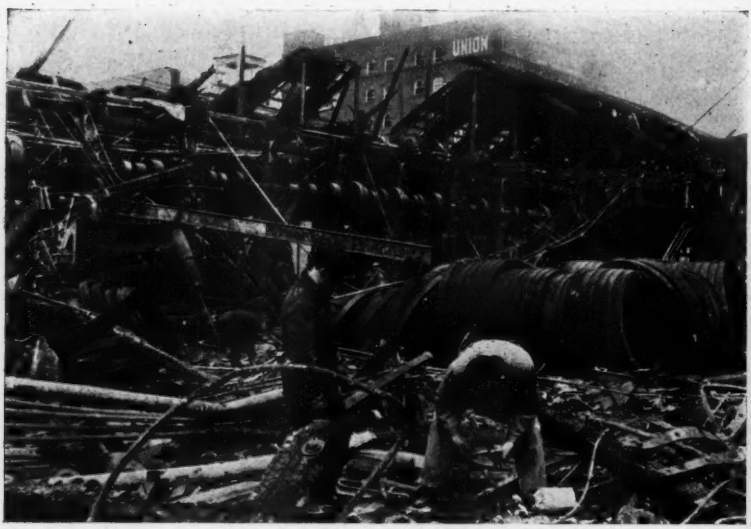


Fig. 1. Ruins of Erie Railroad Shops after Jarvis Warehouse Fire.

Explosion and Fire, Jarvis Warehouse, Jersey City.

March 26, 1918.

Special Report by New York Board of Fire Underwriters, F. J. T. Stewart, Superintendent.
(Member N. F. P. A.)

This fire appears to have originated at 3.07 p. m. in Store C, and the explosions occurred there. This particular store contained considerable chlorate of potash, which had been there for some time, as it was not permitted to be placed in the other stores, all of which were listed as warehouses of a low fire hazard classification. Store C was therefore not so classified because chlorate of potash was stored therein. It will be remembered that the storage of chlorate of potash was largely responsible for the Tarrant explosion in New York City about twenty years ago. The last survey made by this office, March 21, 1918, showed the occupancy of Store C as follows:

Chlorate of soda, chlorate of potash, scotch soot, pitch, sulphate of iron, machinery, wire rods, nails, bleaching powder, band iron, firebrick and peroxide.

Store C was a one-story building or shed of frame and iron-clad construction. The other sections were of brick, with floors of ordinary joisted construction. The area of each was about 20,000 square feet.

Fig. 2. Another view in the Railroad Shops after the fire.

Store No. 2 was six stories high; No. 3 two stories and No. 4 one story; each had a basement.

The stipulations for eligibility to list a warehouse in the low fire hazard class call for a high standard of safety with regard to protection against the fire hazards due to lighting and heating. They also permit no manufacturing processes or other work to be done in the warehouse, the use of which is limited to the storage of merchandise of a low hazard classification. For the purpose of listing, however, there is no stipulation regarding the proximity of other buildings with varying degrees of fire hazards, this feature being separately considered. The loss in these warehouses due to this explosion and some former losses in similar warehouses due to fires in adjacent property of appreciably greater fire hazard call particular attention to the importance of exposure features.

This entire group of four Jarvis warehouses was destroyed, also the Erie Railroad repair shops and adjacent property across 12th Street. There was some slight damage to the plant of the Union Terminal Cold Storage Company across Provost Street.

Central Oklahoma State Hospital Holocaust.

April 13, 1918.

Special Report by Oklahoma Inspection Bureau, C. T. Ingalls, Manager.
(Member N. F. P. A.)

Fire was discovered by night watch in Ward 14 and by a negro inmate in Ward 15 (second floor) about 3:45 a. m., in or near the linen closet in Ward 14, which is near the middle of the building, first floor. General alarm was sounded by whistle at power plant. The city fire department claims not to have been called by telephone until about 4:15. The buildings involved were not within city limits.

Construction of Buildings.

Ward 10.—One-story frame structure, shingle and composition roof, 25 by 175 feet, with "L" 25 by 25 feet on the northwest, situated 80 feet northeast from brick power plant, occupied by negro men—insane but not helpless or violent (weak-minded).

Ward Nos. 14 and 15.—Detached 48 feet northeast from Ward 10, two-story frame construction, with composition roof, 30 by 100 feet; open stair on inside and open stair in rear outside. Occupied on first floor (Ward 14) by white male imbeciles, ages from 14 to 45 years, some helpless; on second floor (Ward 15) by negro males, weak-minded, all ages.

General Dining Hall.—Detached 50 feet northwest from Wards 14 and 15, one-story frame iron-clad construction, composition roof, communicating through unprotected opening with one-story hollow block building on the northeast, occupied as a kitchen.

Extent of Damage.

Wards Nos. 10, 14 and 15 and general dining hall were totally destroyed with their contents; 37 of the inmates of Ward 14 and 1 of Ward 15 (37 white and 1 negro) were cremated. The value of property burned is estimated at between $40,000 and $50,000.

Cause of Fire and How Fought.

The cause of the fire is unknown, some thinking it might have been caused from electric wiring, but there is nothing to substantiate the supposition except the absence of any other apparent cause to which it could be attributed. No electric lights were installed in the linen closet in which fire is supposed to have originated. A slight lightning storm was brewing at the time of fire, but no serious electrical disturbances were noted at or previous to the discovery of the fire. Upon discovery of the fire, a general alarm was sounded by a steam whistle at the hospital power plant, and all ward watchmen, nurses and other employees proceeded

to fight the flames with hand chemical extinguishers and one hose stream of probably 250 feet of 2½-inch cotton rubber-lined hose with 1-inch play pipe. Of course, every effort was made to first get the inmates out of the burning and exposed buildings. It was claimed by the Norman public fire department that they were not called until about 4:15, or until after the fire had been in progress probably thirty minutes. Five men with the triple combination booster pump and chemical hose truck with 1,200 feet of hose responded upon receipt of alarm, and directed their attention toward saving the buildings that were not then on fire—the fire having spread to Ward 10 and the dining hall. They succeeded in saving Wards 13 and 16 and the kitchen adjoining the dining hall. During the fire a moderate wind was blowing from the southeast, and, but for the good work of the public department with the pumping engine, probably several other buildings would have been destroyed. During the progress of the fire, which was quite rapid, the pumper had to be moved twice and two lines of hose abandoned to the flames—about 800 feet having been destroyed.

Apparatus Used.

About twenty-six 2½-gallon hand chemical extinguishers and probably 600 feet of private hose; the public fire equipment, consisting of triple combination booster pump, chemical and hose motor truck, 40-gallon chemical engine, 1,200 feet of 2½-inch cotton rubber-lined hose, three play pipes, 24-foot extension and 12-foot roof ladder, and usual minor equipment.

Private Protection.

Water supply is from the Norman waterworks system through single 6-inch main from standpipe of 85,000 gallons capacity, about 2,000 feet distant; 6-inch circulating yard main and 9 2-way hydrants, outlets having same thread as public hydrants; 600 feet of 2½-inch cotton rubber-lined hose on hand hose cart located in a small frame house on the premises, with supply of play pipes, wrenches and spanners; good supply of 2½-gallon hand chemical extinguishers distributed in the various buildings. Employees were organized into a fire brigade, and it is claimed that drills were held twice a month.

Public Protection.

Water supply is said to be adequate from gravity and direct pumping; water is pumped from deep wells by deep well pumps and air compression system into storage reservoir of 100,000 gallons capacity, and thence by steam pumps of a total capacity of approximately 2,000,000 gallons *per diem*, into system and standpipe of 85,000 gallons capacity (12 feet in diameter and 100 feet high), located about midway between the center of the mercantile district and the State Hospital grounds. It is stated that the standpipe was filled to overflowing at 10:30 p. m. the day before the fire, and pumps were immediately put in operation upon receipt of the alarm on the morning of the fire; an engineer sleeps at the pumping station, and from 80 to 90 pounds of steam is held on boilers at all times. Hand control gate valve on con-

nection to standpipe was not closed, and consequently no direct hydrant streams were available.

Public Fire Department.

Norman.—The State Hospital is outside the city limits, but the department responds to all alarms. The department is part paid and part volunteer—two paid men and twelve volunteers; three volunteers and two paid men sleep at headquarters. Apparatus consists of one triple combination chemical, hose and booster pumper (350 gallons capacity per minute), 40-gallon chemical engine, 1,200 feet of 2½-inch cotton rubber-lined hose, with probably 1000 feet held in reserve, 24-foot extension and 12-foot roof ladders, 2½-gallon hand chemical extinguishers, and other minor equipment usual with such apparatus.

Conclusion.

From information obtainable, it would appear that the fire was fought as satisfactorily as could be expected in view of the fact that removal of the inmates in the wards destroyed was a very slow and tedious procedure, due to their very inferior mental and physical condition. The fire occurring at a time when all were asleep, quite a large proportion of the help which otherwise would have been effective in fighting the flames was needed for the removal of the inmates; and, due to the very flimsy and rapidly combustible construction of buildings involved, the flames spread very rapidly, being fanned by a moderate southeast wind. It would appear that quite unnecessary delay was experienced in turning in the alarm to the public fire department, but no information was available as to the cause of this delay. It is also pointed out that more effective hydrant streams could have been employed had the standpipe been shut off and direct pump pressures applied, as pumps at pumping plant are of ample size to afford at least five good streams, whereas only two fair streams were available with use of the booster pump.

In Wards 14 and 15, in which the fire originated and in which all the lives were lost, there was a total of 86 inmates—37 on first floor and 49 on second floor—one inside and one outside stair being available for exit from second floor. All of the inmates of the lower floor were cremated and one from the second floor. The inmates of the lower floor being of the very lowest mentality, quite a large number of them were gotten out only to rush back immediately into the burning building. It is claimed that one night watch is stationed in each ward, but no approved clock service was employed and no record was obtainable on effectiveness of this service.

Stationary Chemical Extinguisher with Automatic Sprinkler Heads Operates on Fire.

Unusual interest attaches to the fire described below, which is the first reported to the Association involving the operation of a stationary chemical extinguisher. The conditions were very favorable for the operation of the chemical system, and it worked fairly successfully excepting the alarm connections.

Fire started in the rear basement of a retail store building at 1.30 p. m. There is a room about 15 feet square separated from main basement by a wooden partition. A flight of stone stairs runs from one corner of this room to a door opening on an alleyway. The room has mostly non-combustible floor and walls. It was used for packing, unpacking and shipping. There was a small hand-baling press here for baling waste paper. Between this and the stairway was a bale of excelsior and much loose paper and packing materials. The space under the stairs, where there was a sprinkler, was filled with loose packing material. There was also a lot of corrugated paper boxes nearby.

The blaze originated in the loose material, probably from a cigarette or match thrown down the stairway. It was discovered by an employee in the main basement, who opened the door and found the room full of smoke. The superintendent in his office on the fifth floor heard the tank, which is located on the sixth floor, operate, and then got a faint alarm from the electric bell located on the fifth floor. He at once investigated and went to the basement. Finding the shipping room full of smoke, he went outside and walked around to the rear shipping door. Here he found smoke pouring out, so he returned and asked the telephone operator to call the fire department.

The department arrived in from six to ten minutes from the time the chemical tank operated, and used a chemical stream for about two minutes to extinguish the remaining fire.

Both the firemen and the protective department state that the fire was not fully extinguished, but that the tank was practically exhausted when they arrived. The superintendent, however, claims that the fire was entirely out when the firemen arrived. The fire was not severe enough to make it necessary to clear the store, although the help upstairs were ordered to put on their wraps and be ready to leave if requested. The rotary gong failed, and was found afterwards to be clogged, although it had been installed only a few months. The electric bell operated very feebly, and had the fire occurred at night the alarm service would have failed to call assistance and a serious fire might have resulted. The electric bell was operated by three dry cells.

Heads were replaced and system recharged before night. The loss was confined to packing material and old boxes, and is estimated at $75.00.

Points of Interest from Fire Reports.

These notes are intended to illustrate conditions making for or against effective control of fire.

Automatic Sprinklers.

S-20555. Tenant Manufacturing. A small fire occurred in the basement, in a passageway from the boiler room to the coal hole under the sidewalk. One sprinkler operated and entirely extinguished the fire before the arrival of the fire department. The prompt extinguishment was very fortunate, as the blaze occurred close to a frame partition separating the passageway from an adjoining basement well stocked with various sorts of oils, varnish, alcohol and turpentine. Had the fire reached this basement a very serious fire would probably have resulted.

S-20904. Woolen Mill. An employee noticed a flash in one of the cards on the second floor, and very shortly afterwards sprinklers opened overhead. Employees had also started to fight fire with pails and chemical extinguishers. When the fire department arrived the smoke was too heavy to permit the firemen to get near the blaze, but the sprinklers were operating satisfactorily, and the smoke began to change to the color of steam. The chief, believing that the smoke was now mainly steam, and the owners being anxious to avoid water damage, sprinklers were shut off, ladders procured and windows broken at the side. This procedure, by admitting air, caused the fire to break out more violently than before. Sprinklers were again turned on and a hose stream was used, extinguishing the fire with a loss of about $5,000. The loss would have been much smaller had proper precautions been taken to see that the fire was out before the sprinklers were first shut off.

S-21275. Cotton Mill. Foreign material in cotton struck fire in contact with blade of fan when cotton was blown from drier to bin. Fire was discovered in the bin and spread through openings in plank partitions to other bins. In changing the location of the partitions one bin had been left without sprinkler protection, and practically all the damage to the building occurred at the ceiling over the unprotected bin.

S-21671. Automobile Factory. Gasolene had leaked onto the floor beneath a new car which was being tested, and this ignited, apparently from an electrical short circuit in the car. Shortly after the fire had been extinguished, smoke was observed escaping from a low basement under the test room. The floor was badly oil-soaked and fire had evidently worked down through a crack. The basement was an unoccupied space about 4 feet high, and the firemen experi-

enced great difficulty in fighting the fire owing to smoke and inaccessibility. Many holes were cut in the floor and much sheathing was torn away from the side of the building to gain admittance for hose streams, but, due to various foundation piers and other obstructions, it is thought that the hose streams did not reach the seat of the blaze at all, the flames being extinguished by the sprinklers. The loss was small, but the prompt and effective operation of the sprinklers in the basement was all that prevented a serious fire.

Watchman Service.

H-12152. Starch Factory. Corn starch, after being compounded with acids, was placed in large pans and then put into converters. These latter were simply steam coils, with about 100 pounds steam pressure, enclosed in a sheet-metal enclosure, resting on a cement overlay floor. Pieces of burlap from the bags in which the cornstarch was received are believed to have found their way into the compound, to have become nitrated and to have ignited, setting fire to the compound itself in the ovens. The watchman noticed a difference in the temperature when he entered the room, and on investigation found the interior of the oven to be about in the same condition as a furnace. At this point he lost his head, and instead of trying to extinguish the fire with the 1½-inch linen hose located in the room, he ran off to summon help. There is little doubt that the fire could have been extinguished inside the sheet-metal oven; but after valuable time had been lost in summoning the volunteer fire department (the only means of public alarm being the town fire bell), fire worked down through holes around conveyor tubes and belt openings in the floor. The water supply was inadequate, and a number of automatic fire doors were apparently blocked open, possibly by the firemen. The plant was practically destroyed.

H-12165. Foundry. Watchman discovered fire, which originated in a core oven, and walked the length of the building to the offices, whence he tried to send in an alarm over the telephone. Failing to get the desired connection, he went to another telephone, and failed there also. He then used the A. D. T. alarm box, after wasting nearly twenty minutes. The loss was $17,768.

S-21053. Coffin Factory. Watchman saw sparks among shavings near brick shavings vault and under the drop fire door at the vault. He turned a hose stream on the sparks and supposed that he had extinguished the fire, but a little later more sparks dropped down and notified him that there was a fire in the vault. Instead of turning in an alarm through the N. D. T. box, he ran to a nearby fire house. Returning, **watchman closed the door behind him, thus locking the firemen out. The firemen, on arrival, had to break a heavy oak and glass door and then to search for the fire and the watchman.**

S-21073. Shoe Shop. In this case two sprinklers operated and extinguished fire in a rubbish barrel. The watchman, however, who

was an Italian with a limited knowledge of English, was so excited as to be able to express himself only in Italian when the fire department arrived. He was apparently ignorant of the location of the controlling valves, and fifteen minutes were lost before water could be shut off the sprinklers. The water damage exceeded $7,300.

S-21809. Piano Factory. The watchman's dial showed that he was interrupted by the arrival of the fire department, who had been summoned by sprinkler alarm. He explained that there was no trouble and persuaded the firemen that it was a false alarm caused by water hammer. **The firemen returned to headquarters without investigating, and as the alarms continued the watchman shut off the water.** An hour later he heard water dripping through the third floor, and found that there had been a fire in a metal waste can on the fifth floor. Fortunately, one sprinkler had operated and extinguished the fire before the watchman closed the controlling valve. The delay in sweeping out the water involved water damage to the extent of $1,500.

S-22021. Glass Works. Fire occurred in a pile of wood lath close to a nitre shed, which was quickly ablaze. Thirty-nine sprinklers operated in the adjoining packing building, holding the fire in check. If, however, the watchman had been instructed as to the function and operation of the open sprinklers on the latter building, it is probable that fire could have been kept out of it altogether. The loss amounted to about $9,000.

Non-Standard Extinguishing Apparatus.

H-12122. Cement Mill. Grass was set on fire by a locomotive spark and flames communicated thence to a frame bin used for the storage of stone received from the quarries. As soon as the fire was discovered, the centrifugal fire pump was started and a good pressure maintained. Three hundred feet of 2½-inch non-standard cotton rubber-lined hose were available on one hydrant, and about the same length of linen hose on another. The rubber-lined hose was used first, but the length nearest the hydrant immediately burst, and no sooner had this been replaced than another length burst. In all, five lengths of this hose failed. The linen hose, however, stood the strain without any trouble. A loss of $7,000 was incurred, the greater part of the bin becoming a total wreck. **This large loss is directly attributable to the failure of non-standard rubber-lined hose,** as this line was the first run out, and the fire had gained considerable headway before the linen hose could be brought into use.

S-21477. Chemical Warehouse. A wooden barrel containing sweepings and chemical refuse was ignited by spontaneous heating. A non-standard chemical extinguisher was brought, but was found to be practically empty, although the pressure gauge showed 155 pounds pressure. Fortunately, a hose stream was available, and the fire was extinguished with slight loss.

Standpipe and Hose System.

H-12816. Drug Store. Fire started in basement of drug store, and communicated through an unprotected light shaft to the six upper stories. The damage in those stories, however, was comparatively small, mainly because of the standpipes, with hose attached, from which streams were readily directed into the shaft.

Construction.

S-21111. Furniture Factory. Owing to the fact that the fire-resistive ceiling of the boiler room was not bonded tightly to the wall, fire which started in kindling wood in the boiler room communicated to the second story, causing 14 sprinklers to operate. The loss was about $900.

S-21321. Cotton Storehouse. This was an exposure fire. The storehouse was 50 feet to the leeward of the burning buildings, and its walls originally consisted of a single layer of ⅞-inch matched sheathing, a second layer having been added later to cover the joints. The outer layer was burned away in many places, and but for the inner layer the bales of cotton would have been directly exposed. So well was the fire handled that no sprinklers opened inside the warehouse.

S-21497. Cotton Mill. Fire occurred during the afternoon in picker house, and was apparently extinguished by sprinklers and hose stream. A small amount of glowing cotton, however, remained in a space not more than half an inch wide between the outside brick wall and a floor beam. During the night the watchman smelled burning cotton, and investigation disclosed that the floor near the wall was nearly burned through and cotton directly above was scorching. The fire was extinguished with slight damage, but the incident illustrates the necessity of closing up all such spaces wherever located.

H-12856. Tannery. The greater part of two tan yards was destroyed in this fire, but one very interesting feature was that, with the exception of a group in the sweating building, all the vats were enclosed in concrete retaining walls, which prevented their destruction, keeping the hides covered with liquor. A few skins only which were near the top of the liquor were reported injured.

H-13021. Mercantile. Fire originated in the best brick building in the town, and the walls were heavy enough to have held the fire within the building had not the ceiling joists been inserted into the walls. When the upper floor gave way, the joists broke the wall and permitted the fire to spread to ten other structures.

Miscellaneous.

H-12380. Copper Rolling Mill. Fire was discovered just after night gang quitted work. With the assistance of several of the day men, the watchman coupled a hose line to a hydrant in the yard a few feet distant. **The hydrant opened to the right, but in their**

excitement the men attempted to open it by turning to the left. Being unsuccessful, they put a long iron pipe over the wrench and twisted the valve stem off the hydrant. A public alarm was turned in by an employee who entered the yard while the men were laboring at the hydrant, but the fire had gained tremendous headway before the firemen arrived. After running for about twenty minutes, the fire pump was put out of action by the breaking of a large overhead steam main from which the pump was supplied. There was a valve on the main just beyond the connection to the pump, and could this have been closed the pump might have continued in operation. The valve, however, was rendered inaccessible by the heat from the burning building, and it is stated that in any case the heat would have compelled the abandonment of the pump very shortly afterwards. The loss was estimated at between $100,000 and $125,000.

H-12684. Mercantile. This building had a metal ceiling, the paint on which quickly ignited when fire occurred in packing cases below. The paint scaled off in large particles, and the burning particles falling on the merchandise greatly accelerated the progress of the flames. **The loss, which amounted to $9,600, would probably have been much smaller had a fire-retardant paint been used.**

H-12772. Distillery. No alarm was turned in until the building was practically destroyed. Fire occurred at night and afforded a good lesson to the local police, who saw a light in that direction and failed to investigate at once, thinking an iron furnace in the vicinity to be responsible. **Any extraordinary illumination occurring at any time should, of course, be immediately investigated.**

H-12840. Foundry. Fire occurred in a lumber storage room adjoining the pattern-making shop, which was saved by a standard fire door. The heat penetrated, however, through the steel rolling shutters at the elevator shaft opening and burned away the wooden guard railing on the other side. Two shutters were damaged beyond repair.

S-21866. Cordage Works. Rubbish was thrown down a disused chute in the east section of the building, where it came in contact with a steam pipe and ignited. The door at the bottom of the chute evidently was partly open, and the fire flashed out to the edges of three bales of jute about three feet distant. The door then closed by operation of the fusible link and one sprinkler opened, extinguishing the fire in the bales. The chute being unsprinklered, the fire inside it continued to burn. The property was in two sections entirely cut off from each other, a watchman being kept by a tenant in the west section. The fire department, responding to a supervisory alarm, was admitted into the west section by the watchman, but could find no fire. A runner from the central station meanwhile entered the east section and discovered the fire, but not until the firemen had returned to the fire hall, whence they were again summoned by telephone. The fire was extinguished with a loss of less than $600.

Fire Causes.

The fires here given are selected to illustrate defects either of construction or superintendence in the classes of property indicated.

Radiated Heat.

H-12303. Sheet Metal Worker. The air space around a stove pipe which passed through a frame partition became choked with dirt, thus preventing the necessary circulation of air to keep the ventilating jacket cool. Fire occurred from overheating of pipe and jacket during zero weather while a very hot fire was kept going in the stove.

H-12330. Machine Shop Pattern Storehouse. A metal stack venting hardening furnaces was within half an inch of a joist supporting the corrugated iron roof of the hardening building. This joist was in contact with the ends of joists in the adjoining pattern storage building, the tile division wall not extending through the roof. The heat in the hardening furnaces often reached 1,200°, and the roof joist close to the metal stack became charred and finally took fire. Fanned by a stiff breeze, the flames communicated to the roof of the pattern storage building. The loss was over $6,000.

H-12341. Printing Establishment. The gas pressure to an automatically regulated gas-fired heating boiler fell very low during the night, causing the regulator to open fully. After midnight the pressure increased, but the regulator failed to operate, with the result that boiler and flue became overheated, igniting ceiling over boiler. Fire communicated to upper floors and roof, causing a loss of $18,000.

H-12449. Door and Sash Factory. This was the third fire of its kind in a fire-resistive shavings vault abutting directly against a brick boiler setting. Insufficient protection of brickwork between interior of vault and boiler caused the walls to become hot enough to ignite the shavings. The fire was discovered promptly by the watchman and extinguished before it had gained headway.

S-21255. Cotton Storehouse. Watchman heard water running and found sprinkler operating on fire in bales of cotton next to brick wall separating storehouse from boiler house. Fire was undoubtedly due to the presence of chemicals on the bagging of the baled cotton, ignition occurring as the result of heat radiated through the wall.

H-12612. Laundry. On arrival in the morning employees found an ironing table on fire. This table was of wood, but was covered with a thick cloth pad. An electric pressing iron was left standing

on the table, but this had been disconnected from its wiring. It would seem probable, therefore, that the heat from the iron had set fire to the pad on the previous evening, and that the fire merely smouldered until early the following morning.

H-13073. Paper Mill. The stock in the burned building was principally rolls of paper piled against a blank wall. Employees state that a flash appeared over the rolls, and spread so rapidly that they had to flee, leaving their coats behind. After an hour's work the firemen succeeded in confining the fire to this one building. During the fire smoke and steam were seen coming from a pile of soft coal outside banked against the wall of the structure. The coal was removed, and on the outer side of the wall a space about six feet square gave evidence of having been white hot, the concrete slabs having been crumbled by the heat. The fire inside the building is attributed to excessive heating of the wall by the burning coal on its outer side, the paper which ignited being stacked against the wall on its inner side.

It was stated that employees detected an odor of gas in the room a few hours previous to the fire. It is possible that this gas may have accumulated from the heating of the coal at different points and have entered the building through crevices in the wall, finally igniting at the spot where the fire was burning. The fire in the coal was not discovered until water was thrown on it, resulting in the rising of steam.

Oily Material.

S-20510. Tenant Manufacturing. Without the knowledge of the management, **the night watchman kept five gallons each of turpentine, kerosene, benzine and lubricating oil in a wood closet in the basement.** These commodities he was in the habit of selling to the tenants. Overalls or rags in the closet became oil-soaked and ignited spontaneously. The closet being sprinklered, the blaze was extinguished with slight loss.

S-20511. Machine Shop. A few nights before the fire the watchman discovered a leak in the roof. Dumping rubbing rags into a wooden barrel, he used the metal container provided for such rags to catch the water coming through the roof. He neglected to empty the wooden barrel, and in due time spontaneous ignition occurred. One sprinkler operated and extinguished the fire.

S-20607. Laundry. Fire occurred in a wooden truck containing about 100 pounds of cloths which were used to wipe machinery in a nearby shoe factory. These cloths were part silk, and when dirty were sent out to be washed. On the present occasion they had been washed with soap and water, and had been dried in a tumbler drier at a temperature of about 190° F. From the drier they were packed into the truck in such a manner that heat could not radiate easily, and it is supposed that spontaneous heating was started by the drying process.

Inflammable and Explosive Gases and Vapors.

S-20601. Harness and Fancy Leather. An acetone-dissolved pyroxylin cement was being spread on belts near to and about a foot above a glue pot heated by an open gas flame. Acetone vapors were ignited, and although sprinkler operation promptly extinguished the fire, considerable water damage to machinery and stock resulted.

H-12002. Packing House and Slaughter. An unusual quantity of smoke was observed issuing from one of the smoke-houses at this plant. As soon as the door was opened a heavy explosion occurred, the walls of the smokehouse being cracked and distorted at the second floor, the heavy metal doors thrown open and burning meats and grease scattered over the floor and exposed woodwork. Most of the employees were at lunch at the time, and some delay occurred in turning in the alarm. One negro was painfully burned, and a property loss of more than $10,000 was incurred.

It is believed that carbon monoxide gas was generated by the incomplete combustion of the hickory wood in the smokehouse. When the door was opened and oxygen in the air mingled with the carbon monoxide in the presence of the fire in the base of the smokehouse, an explosive mixture was formed.

S-20835. Munitions Factory. Fire occurred in building where gun cotton was converted into smokeless powder by mixing with ether solvent. The mixers had heavy iron tight-fitting covers bolted on to the machines. An employee was striking the iron clamp which held the head of a press in place, with the object of opening same, when a spark flew from the brass hammer he was using and ignited some cotton dust in the vicinity of the press. Ether vapors throughout the building ignited, giving off sufficient heat to open all the sprinkler heads.

H-12783. Dairy Laboratory. A quart can of amyl acetate bronzing lacquer was kept on a cupboard about 18 inches from the top of a small gas-fired sterilizing oven. The heat from the oven is supposed to have caused pressure in the can, either by volatilizing or decomposing the liquid, or both. In any case, the can burst and the flame under the oven instantly caused a moderate explosion, followed by fire. The chemist filled a water pail in a nearby sink and extinguished the small fires in the room. He had a narrow escape, as burning liquid was thrown on his clothing. The property loss was trifling.

Electrical.

H-12158. Transformer Station. The regular operator of the station, being ill, had been relieved by an inexperienced man. The electrolytic lightning arresters had been charged, but by accident two tanks of the arrester set were left in contact with a 30,000-volt circuit. Ordinarily, thirty seconds is the period allowed to charge these arresters. The continuous contact with the high voltage caused the oil in the arresters to heat, and in time ignition occurred. The oil

overflowed while burning, destroying the arrester set. Burning oil also dripped through a few small holes in the concrete floor over a 1350 K. W. oil-cooled transformer, the insulation on leads from the transformer being burned. Wooden window frames and a wooden door also caught fire. The loss was reported to amount to $4,500, but it was stated that water forced into the transformer case by the fire department caused greater damage than did the fire itself.

Pulverized Coal.

S-20909. Bolt and Nut Factory. The nut furnaces were fired with pulverized coal stored in metal hoppers in front of the furnaces. Hoppers held twenty-four hours' supply and were filled by screw conveyors as necessity arose. At time of fire one of the hoppers was being filled and the conveyor was not stopped when the hopper was full. An overflow device was provided, but this was designed to handle only a small amount. In the present instance the powdered coal escaped and was ignited on reaching the hot furnace. The floating dust formed a path for the flames to reach the hopper, and dust which had lodged in the monitor and in various parts of the roof also took fire. The blaze spread with startling rapidity and developed great heat. Sprinklers operated, however, and were very effective in extinguishing the blaze.

This fire emphasizes the need of constant vigilance where pulverized coal is used as fuel.

Fuel Oil.

H-12183. Bakery. In violation of city ordinances, a fuel oil feed pipe to burners under bake ovens was installed along the wall of a room. An explosion under a bake oven broke this pipe and, the pump immediately speeding up, the oil discharged into the room greatly assisted the spread of the flames. The loss was heavy.

H-12878. Foundry. Two weeks prior to fire an oil furnace was installed, with a dual system of supply tanks of 60-gallon capacity under 5 pounds air pressure, located 18 feet from the furnace. The tanks were filled from barrels of oil suspended above, the sand around them becoming oil-soaked. Hot metal from a bursting ladle ignited the oil-soaked sand, and the intense heat generated a gas pressure sufficient to burst the supply tank.

Open Spaces Under Buildings.

H-12211. Mercantile. The building was four feet above the ground and, the day being cold, children playing under it had built a fire to keep themselves warm. The day was Sunday, and consequently considerable delay occurred in turning in an alarm. The loss was $31,000.

H-12564. Sash and Door Factory. Fire occurred in an open space under the building, which was an old railway freight station. This space was about 3½ feet high, and all shafting ran below the floor of the building. The resulting loss exceeded $160,000.

Miscellaneous.

H-11932. Jewelry Shop. The same air compressor was used for sand blasting by air pressure process as for supplying air to be mixed with city gas at burners of annealing stands and enameling furnaces. It was claimed that gas leaked back into the air pipes and was ignited by a back draft, thereby causing an explosion at the weakest point, which was in the tin piping inside the sand blast cabinet. The stops in the gas piping at the burners had not been located so as to prevent gas getting into the air piping, this evidently having been connected subsequently to the installation of the original system.

S-20541. Department Store. Coffee roasting was done in the presence of customers as part of the process of selling coffee. The roaster was installed in a portion of the basement which was used for displaying and selling groceries. The coffee was roasted, in batches averaging 75 pounds each, by rotation inside a wire mesh cylinder exposed to four gas flames. A fan, driven by belt from a small motor, drew the hot air from the cylinder and forced it through a venting pipe to the chimney. The fan also cooled the roasted batch in pan under machine by drawing off the heat through the same vent pipe. Fire was caused by the employee in charge allowing the coffee to remain in the roaster too long. No thermometer was provided at the roaster, and the duration of roasting was in the discretion of the employee, the margin of safety being, however, very small. Smoke and flames were noticed coming from the machine, and as the store was crowded with shoppers, considerable confusion ensued. The employee in charge forgot to turn on a water jet which would have extinguished the fire immediately; other employees in their excitement emptied chemical extinguishers over green and roasted coffee in the vicinity. Eventually the gas was shut off at the machine and a chemical extinguisher emptied into the roasting cylinder, extinguishing the flames before much damage was done.

This fire suggests the possibilities of panic when such processes are left without automatic control in charge of men having other duties in large display rooms which are liable to be crowded.

H-12560. Wooden Box Factory. Fire was caused by a boring machine connected to the main blower system. The machine cut 3-inch holes in strips of yellow pine. Normally the disc of wood cut from the strip fell to the floor below the machine, but one disc became stuck in the cutting form without being observed by the operator. When a new strip of wood was inserted, the disc in the cutting tool was forced down on the wood and revolved at considerable speed, generating by friction sufficient heat to cause the wood to ignite. Sawdust passing into the blower system was also ignited, but owing to prompt discovery of the fire the blower was stopped before the fire reached the fan. The blower ducts were provided with hand holes, and the blaze was promptly extinguished by chemical extinguishers discharged through these holes.

H-13038. Cereal Mill. Wheat from one of the bins at this plant was being drawn from the bottom, elevated with the bucket elevator and re-deposited in the bin for the purpose of airing it, when a slight fire was discovered around the motor on the floor of the elevator housing on the roof of the bin. A chemical extinguisher was used and all signs of fire disappeared. Several weeks later the wheat was drawn upon for use, and a slight odor of burned stock was noticed as it passed through the cleaning building. Subsequently it was found that this wheat was fit only for poultry food.

It is believed that before the fire already mentioned had been extinguished some live embers fell through one of the 3-inch holes in the roof of the bin, through which two planks supporting the motor were bolted to the concrete. These embers lay unnoticed, and during the weeks in which the bin remained closed the entire body of stock became affected by the smoke.